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ABSTRACT

This guide is designed to help driver education teachers in Iowa to integrate energy conservation education into the traditional high school driver education course. Following an explanation of the necessity for teaching energy conservation with driver education, the course guide is divided into seven units. The units cover vehicle selection, vehicle maintenance, vehicle operation, environmental conditions, traffic strategies, planning for savings, and exploiting alternative methods of transportation. Each unit contains an information section, transparency master, learning exercise, learning aids, true/false learning exercises and feedback, and a test with answers. Materials are suitable for reproduction and handout to students. The appendix contains a list of fuel-efficient instruction techniques, a guide and test to the film "Running on Empty," Kodalith instructions and slide masters, flowcharts, and a bibliography. (KC)

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Energy Education Resource Guide for Driver Education

Sponsored by:
Iowa Energy Policy Council
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Experience is a tough teacher.

It gives the test first. . . . .

and. . . gives the lesson later.

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The Money Crisis. . . . . Why We Must Act Now.

"I don't have time." "The kids will hot rod anyhow." These are some arguments against integrating energy education into the driver education course. These arguments just don't make sense to people who understand the economic impact that energy costs have on our local, state, and national economies. What's at stake is the viability of our economy, jobs, and tax base. On a more personal level, our standard of living is gradually being eroded by the dollar drain for oil, gas and coal.

The Truth About Curriculum

Energy education is not being offered instead of driver education. It is intended to be integrated into the traditional driver education course. The *Iowa Energy Education Resource Guide for Driver Education* cannot be considered a substitute for your textbook. It deals with traditional content (driver habits, vehicle and environment) from an energy-efficient point of view. The fact is that you will be teaching the same content with an energy-efficiency emphasis. A plus is that students who have been taught to be fuel-efficient drivers concentrate more on the driving task than traditionally taught students. This is because drivers must concentrate to be fuel-efficient in traffic. The end result is that we have fewer distracted and inattentive drivers, and incidentally, safer drivers. This is not to suggest that all of our students will be energy-efficient drivers at the end of the course, but doing nothing about the problem is not the better answer.

Today Is the Day

Nothing about the energy problem is written in stone. At this writing (1981) there is a temporary oil glut with downward pressure on petroleum prices. This should not cause us to take our eyes off the central problem, the economic impact oil is having on our young people. Our young people have 60 to 70 years of driving ahead of them. Think of the economic impact you can have on the lives of your students. That impact will continue after you have left this earth.

Earlier, the viability of our economy was mentioned as an important reason for teaching fuel efficiency. As part of the energy education project a media program was developed and presented to superintendents of each of the area education agencies in Iowa. The following rationale has been seen and endorsed by most of the school superintendents in Iowa:

1. Iowa is an energy-poor state. We must import 98 percent of all energy consumed. This immediately creates an economic impact because nearly all of the money spent for energy leaves the state.

2. On the national level, the magnitude of the dollar outflow can be visualized best when it is understood that the $90 billion we export each year in exchange for foreign oil equals the assets of Ford, GM, GE and IBM.

3. This outflow of capital is creating a very negative effect on our lives. For example, GM must delay the development of a super-efficient three-cylinder as well as a high-tech four cylinder, two-cycle diesel engine because of a lack of capital. Meanwhile, OPEC countries are rapidly industrializing.

4. What is the effect on us personally? First, our tax base is reduced because money spent for energy cannot be spent or invested in the local economy. As a result, young people are without jobs because a lack of discretionary money is keeping people out of stores, restaurants, and other businesses. No teacher in the state can be unaware that our state treasury is short of funds. This has had a direct effect on our schools and on teacher salaries.

What Is the Answer?

Do not be deluded by temporary conditions. The stark fact is that regardless of where it comes from, Iowans will have to pay an ever-increasing price for fuel. It is folly to suggest that we stop using energy to save our economy and our standard of living. What we can realistically suggest is to be more efficient in all kinds of energy uses.

Why Is Conservation a Good Route to Take?

There is no strong conservation ethic in our population. *Cost* is the big motivating factor we have been able to identify with the high school group. We have found that $25 for a tank of fuel is something all drivers can understand. What are the advantages of conservation?

1. Conservation costs very little compared to other alternatives. It is not possible to trade an old car in good condition for a new, high-tech car and regain the cost with fuel savings. Synfuels and shale oils are a long way off in commercial quantities. When we do get them, they will be very expensive.

2. Conservation has an immediate effect. The recent downturn in price is an immediate effect of lower consumption in the U.S.A.

3. Conservation directly benefits the individual who works at being more fuel-efficient. Dollars thus saved will most likely be spent in the local economy or invested to form capital for business and industry. This will help to "rev up" demand in businesses where our young people can be gainfully employed.

A Unique Opportunity

We need a highly organized energy information transfer system in Iowa. The media provides this service, but there is one important flaw. Too often the contents of messages deliver misconceptions that are counter-productive. "Accelerate briskly." "Use air conditioners instead of having windows down." These are just two examples of information that will cause drivers to waste fuel instead of saving it.

We need energy advocates in each community in the state. Each driver-educator must take the lead in his or her community to be sure that we use fuel in the most efficient manner possible. Ask yourself the question, "Will this community be a better place because I have been here and made a contribution?" Today you have a unique opportunity to make an unusual and important contribution to your town, to your county, to your state, and to your country.

What Can You Do?

The sky is the limit. When our pilot teachers gathered in Des Moines for the final critique of the project in April, each related a *different* way of implementing the energy content in their community. These people were doing a highly creative job of adjusting to local conditions. They were doing a highly creative job of exploiting opportunities to involve other teachers in other areas.

Here are some of the ways you can make contributions in your own community:

1. Energy content can be integrated into other courses just as it is being integrated into traditional content in driver education.

2. You can tell your story to the local media. All of our pilot teachers received extensive and positive coverage.

3. Service clubs and other community agencies will want to exploit your knowledge and your expertise.

4. Some of our people are starting adult education programs by offering energy clinics.

5. You can be the consultant to your school district, city, and county fleets as well as those of utilities, industrial, and business organizations.

Now Is the Time

Your superintendent of schools has been briefed on the driver education energy conservation program. You will be an unusual exception if your school administration is not solidly behind this effort. They want the job done now.

Two Important Needs

To be a successful energy advocate in your community, two important needs must be met:

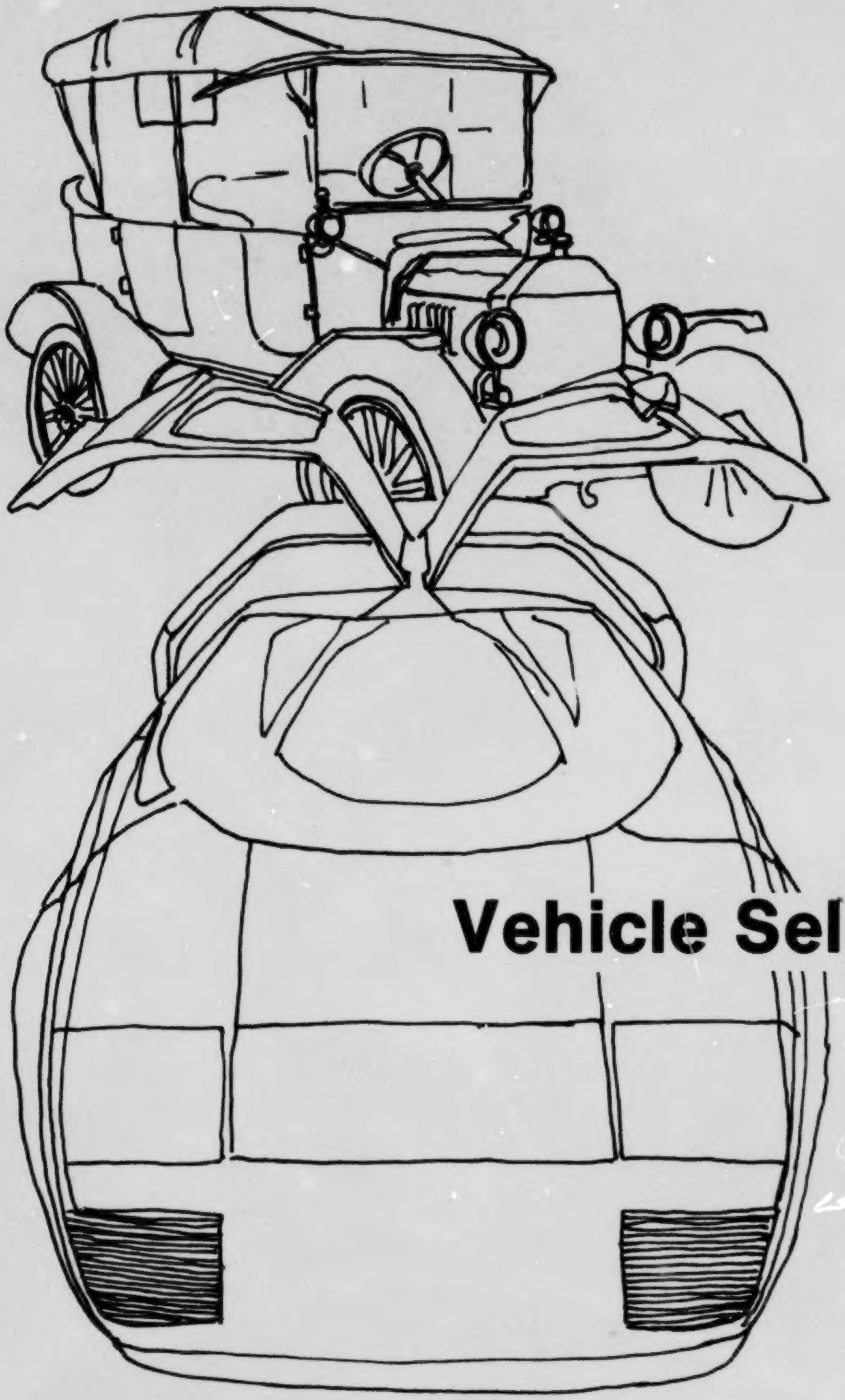
1. You must have *knowledge*. *The Energy Education Resource Guide for Driver Education* is a quick way to become informed. This is an energy primer. Start a file system and build your storehouse of information.

2. You must become *committed*. We need the commitment of all the teachers in the state. We must perform a highly critical task in an exceptionally effective manner. It can be done because our pilot teachers have carried the "energy-economy" message to the school superintendents of our state.

It's Our Ball Now!

The ball is now in our hands. Throughout the state our school administrators are expecting results. We stand at a unique point in history. We can make an understanding and long-lasting contribution. The driver educators of Iowa can deliver safety education and fuel-efficient driving at the same time if we become informed and perform our task with commitment. We can succeed!

Vehicle Selection



Vehicle Selection

1.0 Vehicle Selection

Drivers can make wiser choices when they consider all vehicle factors that influence cost of fuel and overall cost of ownership.

1.1 Transportation Needs

The single vehicle owner should select a vehicle that will handle the load most frequently carried. Owners of two or three cars should develop a mix of vehicles, each specialized to handle specific needs.

1.2 Weight

Weight of a vehicle strongly influences fuel consumption. The heavier a vehicle, the more fuel is needed to speed it up and keep it moving.

1.3 Frontal Area

The greater the frontal area of a vehicle, the more power is needed to move it through the atmosphere.

1.4 Engines

Generally, the larger the engine, the more fuel it will burn. Smaller engines usually produce better fuel economy.

1.5 Transmissions

Standard transmissions can be more economical than automatics, but lack of skill and abuse can quickly erase the advantage.

1.6 Fuel Economy (Gas Mileage)

Cost of fuel is not cost of ownership. A low cost older car with lower fuel economy can provide low cost transportation if all known fuel saving techniques are used.

1.7 Power Options

The added weight of power options and the power needed to run them can reduce fuel economy.

1.8 Crashworthiness

Fifty miles per gallon has no meaning if you do not survive a crash.

1.9 Research Before You Buy

It is far less costly to learn all about a vehicle before you buy it than to learn by experience after you have it.

1.0 Vehicle Selection

Objective:

Select a vehicle that will provide maximum usefulness with the lowest total ownership cost.

1.1 Transportation Needs

Objective:

Select a vehicle that will move typical loads at a minimum cost for fuel.

A. Avoid making a selection on the basis of once-in-a-while needs. Consider renting a vehicle for unusual needs.

B. If you have two cars, you may wish to own one that can carry more passengers and heavier loads and one "person mover."

C. If your annual mileage is lower than 5,000 miles, it is doubtful that you can pay for the cost of a new car with fuel savings.

D. At $1.25 per gallon, a driver who drives 5,000 miles per year in a vehicle producing 15 miles per gallon will spend $416 per year for fuel. In 10 years that individual will spend about $4,160 for fuel.

1.2 Weight

Objective:

Closely match the vehicle you choose to the weight you will usually carry.

A. Add a 100 pound weight to a 1,800 pound car, and gas mileage declines about 5-6 percent.

Add a 100 pound weight to a 5,000 pound car, and gas mileage will go down .28 mpg (McDonnell-Douglas Corp).

B. Larger cars with larger engines suffer less from added weight than do smaller vehicles.

C. Small is not always economical. See *EPA* (Environmental Protection Agency) *Mileage Guide*.

D. One compact vehicle may have 1-1/3 more cargo space than another.

E. In small, high-mileage vehicles, adding one person to the load has been known to cut fuel economy 5-6 percent.

F. Weight directly increases rolling resistance of the tires.

G. Each 100 pounds of weight added to a mid-size vehicle reduces fuel economy by one percent.

1.3 Frontal Area

Objective:

Select a vehicle with a small frontal area.

A. Each two percent increase in frontal area decreases gas mileage by about one percent.

B. Air resistance or air drag begins to take effect at about 30-35 mpg.

C. Double your speed from 30 to 60 mph and air drag becomes not twice as great, but four times greater. Power demand becomes eight times greater. The same rule applies when you drive at 30 mph into a 30 mph wind. Your air speed is then 60 mph.

D. At 55 mph, about 60 percent of your fuel is needed to overcome air resistance.

E. If your vehicle is driven largely at slower city speeds, frontal area is not as crucial as it would be for higher rural speeds.

1.4 Engines

Objective:

Closely match the engine to the vehicle and the load it will be moving.

A. An underpowered, heavily overloaded vehicle will produce poor gas mileage.

B. A small vehicle equipped with a large engine will waste fuel.

C. A rule of thumb on engine choice is as follows:

1. Four-cylinder engines for small cars
2. Six-cylinder engines for medium size cars
3. Eight-cylinder engines for larger cars with heavy loads

D. Diesel Engines

	Gas Engine	Diesel	Difference
Olds Delta	(307) 17 mpg	(350) 23 mpg	35%
Olds Cutlass	(260) 19 mpg	(350) 23 mpg	21%

Advantages:

1. Better mileage in short trips, lower speeds and stop-go driving
2. More energy in a gallon of fuel
3. No choke or fast idle during warm-up
4. Longer range per tank of fuel

Disadvantages:

1. Hard starting with some early model diesels in cold weather outdoors
2. Slower acceleration
3. Higher engine costs. At least 50,000 miles to break even with fuel savings

4. Some smoke and odor problems. Effect of carbon particulate on health is unknown.

5. Maintenance requirements higher, parts are more expensive and competent mechanics are not widely available.

The Future:

1. U.S. auto manufacturers' experience with diesel engines is limited. We can be sure that disadvantages will be reduced if not overcome.

2. Due to the limit of the amount of diesel fuel that can be gained from a barrel of crude oil, the number of diesel vehicles in use will be limited. Alternate fuels may change that.

3. Most trucks and tractors will be diesel powered. This may cause a shortage of diesel fuel.

E. Engine Size

Generally, the larger the engine in a given vehicle, the poorer the gas mileage. (*EPA Gas Mileage Guide*)

Zephyr--Mid-Size	**Per Mile Cost @ $1.20 per Gal.**	**Per Mile Cost @ $1.50 per Gal.**
4-cylinder - 22 mpg	5.4 cents	6.8 cents
6-cylinder - 20 mpg	6.0 cents	7.5 cents
8-cylinder - 18 mpg	6.6 cents	8.3 cents

1.5 Transmissions

Objective:

Select a transmission that will give maximum fuel economy under loads and conditions most frequently encountered.

A. Manual Shift

1. Four-speed transmissions are usually standard equipment on most vehicles.

2. Five-speed transmissions are extra-cost items. The extra cost may be gained back with fuel savings. When most driving is done under speeds of 30 to 35 mph, the fifth gear cannot be used and payback in fuel savings is not possible.

3. The *EPA Gas Mileage Guide* shows many automatic transmissions giving better fuel economy than manual shifts. This is due to excessively high shift speeds required in the tests. GM user surveys show manual shift fuel economy to be about 13 percent higher than auto shift vehicles.

4. If a manual shift vehicle is driven abusively or if the shifting speeds specified are not followed, fuel economy will drop.

5. If a driver is not skilled in the handling of a manual shift transmission, poor fuel economy may result. Top fuel economy with manual shift vehicles depends on skillful shifting at the right speeds.

B. Automatic Shift Vehicles

1. Automatic transmissions are an extra-cost item. It is doubtful that an owner could justify one as a fuel saving expenditure.

2. Fuel economy of automatic transmissions is being improved and is fairly close to that of some standard transmissions.

3. Overdrive transmissions are extra-cost items. It is doubtful that one could gain payback in gas savings under ordinary driving conditions.

a. 1981 Oldsmobile	4-speed - 17 mpg	3-speed - 16 mpg
b. 1981 Ford	4-speed - 16 mpg	3-speed - 16 mpg

EPA Gas Mileage Guide

4. Drivers who drive high annual mileage at highway speeds (above 35-40 mph) might gain fuel savings with a four-speed auto shift vehicle.

1.6 Fuel Economy (Gas Mileage)

Objective:

Before buying a new or used vehicle, research the gas mileage potential of the type of vehicle you are considering.

A. *Gas Mileage Guide* - Back issues to 1975 are available.
Current issues available from auto dealers.

B. Fuel economy range for each type vehicle (*Gas Mileage Guide* 1981)

Sub-Compact	16 to 42	Mid-size Wagon	16 to 24
Compact	16 to 28	Small Pickup	20 to 27
Mid-Size	16 to 25	Stand. Pickup	13 to 20
Large Car	16 to 23	Van	12 to 17
Small Wagon	19 to 32	Special Purpose Vehicle	12 to 25

C. Comments:

1. Four American mid-size vehicles exceed the gas mileage of 61 sub-compacts. (188 vehicles in sub-compact class.)

2. These four American mid-size cars exceeded the mileage of 18 compacts. (21 vehicles available in this class.)

3. Best mileage of any large American gasoline-powered car exceeded the mileage of 11 sub-compacts and 43 mid-size cars.

4. Large diesel-powered cars with 23 mpg exceeded the mileage of 32 sub-compacts, 12 compacts, and 69 mid-size cars.

5. A small car may not necessarily provide economy and a large car may be fairly fuel efficient.

Based on lab tests, not actual road conditions.

D. How Fuel Costs are Affected by Gas Mileage

(Figures are based on 10,000 miles per year)

MPG	Cents Per Mile	@ $1.20	Gallons	Gal. Saved Per Year	$ Saved Per Year
10	12	$1200	1000	-----	-----
15	8	800	666	334	$400
20	6	600	500	166	200
25	4.8	480	400	100	120
30	4	400	333	77	92
35	3.42	343	286	47	56
40	3	300	250	36	43
45	2.6	264	222	28	36
50	2.4	240	200	22	26

1. How many gallons and dollars can be saved by driving a vehicle that produces five mpg better gas mileage:

   15 mpg instead of 10 mpg ______ gallons $________
   25 mpg instead of 20 mpg ______ gallons $________
   35 mpg instead of 30 mpg ______ gallons $________
   50 mpg instead of 45 mpg ______ gallons $________

2. When you consider a highly fuel-efficient vehicle, carefully weigh the trade-off you are making in safety, utility, and comfort for a small annual dollar saving.

1.7 Power Options

Objective: When selecting a vehicle, hold the number of power accessories to the lowest practical level.

Power Options:

1. Power options add to the cost of a vehicle but they also may increase resale value.
2. The more power options you add, the more money you may eventually spend for maintenance.
3. Test drive a vehicle without power steering and brakes to see if it handles well without them.

4. Manual steering requires about 30 percent more steering wheel movement to gain the same steering effect. This could make evasive steering and skid recovery more difficult.

5. When power accessories are added to some small cars, a larger engine may be needed. This adds further to fuel and ownership costs.

6. Good driving habits save enough fuel to compensate for the use of power accessories.

7. On some small cars it is more economical to drive with the windows lowered than to turn on air conditioning.

1.8 Crashworthiness

Objective:

Select a vehicle that can protect you in a crash.

A. Fuel economy is a moot issue if you do not survive a crash.

   1. *You are safer wearing restraints in a small car than you are unrestrained in a large car.*
   2. *Riding in a car that has passed the "crash test" does not mean that you will be safe without restraints.*
   3. Foreign-made cars do not do as well in the official crash tests as do American-made cars.

B. There are disadvantages with small cars.

   1. Break-away poles do not always break when hit by a small car.
   2. Guard rails that throw large cars back into their lane tend to cause small cars to overturn.
   3. In 97 percent of all small car-truck crashes the fatalities were in the small car. Trucks will not become smaller and some will become larger.

C. Summary

   1. Survival in any car, and especially small cars, depends on concentration and keeping your vehicle out of the way of others.
   2. Fasten your restraints each time you drive regardless of the length of the trip.

1.9 Research

Objective:

Study the literature on test data compiled on the particular class of vehicle you desire.

1. Classifications such as "Sub-Compact," "Compact," "Mid-Size " and "Large" are made on the basis of passenger and cargo space.
2. Some compacts with the same outside size may have a third more space.

Sources:

Consumer Information Center, Pueblo, Colo. 81009

1. *Gas Mileage Guide* (35 pages) Back issues are available. Auto dealers must make current issues available in show room.
2. *The Car Book* (68 pages) Covers new and used cars.
3. *Cost of Owning and Operating Cars and Vans.*

Magazines:

These are found in most school and public libraries.

1. *Consumer Reports*
2. *Consumer's Research*
3. *Motor Trend*
4. *Car and Driver*
5. *Popular Science*
6. *Popular Mechanics*
7. *Mechanix Illustrated*
8. *Hot Rod*

Look at back issues to cover the year vehicle (s) you wish to research.

Answers for page 16

1) c (1.1), 2) a (1.2), 3) a (1.3), 4) a (1.4, 5) a (1.4), 6) c (1.5),
7) a (1.5), 8) (1.6), 9) d (1.6), 10) d (1.7)

Ideal Vehicle

1. Based on transportation needs
2. Light weight
3. Engine matched to usual load
4. Transmission. . . . not always stick shift
5. Minimum number power accessories
6. Minimum frontal area
7. Efficient aerodynamic design
8. Most fuel-efficient vehicle in class

True/False Learning Exercise — Vehicle Selection

1. The greater the frontal area of a vehicle, the poorer your gas mileage.
2. You should select a vehicle that will handle the greatest load you are likely to carry.
3. By trading a large, 15 mpg car for a new, 30 mpg small car, you can quickly regain your cost in fuel savings.
4. Small cars are affected more by a load than are large cars.
5. On a given vehicle, the larger the engine, the poorer the fuel economy.
6. Stick shift cars always produce better gas mileage than do auto shift cars.
7. Some mid-size cars produce better gas mileage than many compact and sub-compact cars.
8. Cost of fuel is the greatest cost of ownership.
9. When you double your speed from 30 mph to 60 mph, air resistance doubles.
10. Small vehicles are affected more by the addition of power options than are large cars.

True/False Feedback — Vehicle Selection

1. T The more square feet of frontal area you try to push through the air, the more fuel and the more dollars it will cost.
2. T You should consider renting a vehicle for that unusual load. That way you can avoid lugging all that vehicle weight when you don't need it.
3. T When you trade a $2,000 car for an $8,000 car, it will take a very long time to get a $6,000 pay-back in fuel savings.
4. T It's a matter of big engines with more muscle taking extra loads with minimal effect.
5. T This is generally true, but don't opt for a little engine if you plan to move big loads under difficult conditions.
6. F In a surprising number of instances, automatic shift cars produce better miles per gallon than their stick shift counterparts.
7. T According to the *EPA Gas Mileage Guide*, a number of mid-size vehicles produced better miles per gallon than a number of compact cars.
8. F The greatest cost of ownership is for original cost, interest, insurance and repairs.
9. T When you double vehicle speed, air resistance becomes four times greater.
10. T The added power needed to move and operate power options has a greater negative effect on small cars with small engines.

Learning Aid

Iowa Energy Project

Dollar-Saving Ideas For Fuel-Efficient Drivers

Vehicle Selection

1.1	How might "two-car" owners solve the dual problem of heavy loads on one hand and moving a single person on the other?	1.__________
1.1	Is it possible for a low-mileage driver to quickly regain the cost of a new small car with fuel savings?	2.__________
1.2	Which size vehicle is able to carry extra weight without a serious reduction in gas mileage?	3.__________
1.2	Are all compact cars alike in cargo space?	4.__________
1.2	What effect does weight have on rolling resistance?	5.__________
1.3	At what speed does air drag begin to be important?	6.__________
1.3	At 55 mph, what percentage of your power is needed to overcome air drag?	7.__________
1.3	Is air drag important at city speeds?	8.__________
1.4	What is the effect of a small engine in a heavily loaded car?	9.__________
1.4	In the spaces to the right, match the ideal engine size to the vehicles listed.	10. Compact - __________ 11. Mid-Size - __________ 12. Full Size - __________
1.4	How much more fuel economy should you expect from a diesel engine?	13.__________
1.4	List two advantages of diesel engines.	14.__________ __________
1.4	If you usually carry four people in a small car, what size engine would be best?	15.__________
1.4	What happens to gas mileage when larger engines are installed in a vehicle?	16.__________
1.5	Are five-speed transmissions always more economical than four-speed transmissions?	17.__________
1.5	Should one automatically assume that buying a manual shift will guarantee better gas mileage?	18.__________
1.5	Why is an overdrive not cost-effective in city traffic?	19.__________

1.5 Should an owner expect greatly higher gas mileage from an overdrive? 20. ____________________

1.6 Does buying a small car always mean that it will be economical on fuel? 21. ____________________

1.6 Is it possible to buy a mid-size car that will give better gas mileage than a sub-compact? 22. ____________________

1.6 Do you suspect that an American mid-size would provide better protection than would an imported sub-compact? 23. ____________________

1.6 Refer to the chart on page 7 . How many gallons and how many dollars can be saved by driving a vehicle that produces five mpg better fuel economy?

24. 15 mpg instead of 10 mpg _____ gallons _____ dollars

25. 25 mpg instead of 20 mpg _____ gallons _____ dollars

26. 35 mpg instead of 30 mpg _____ gallons _____ dollars

27. 45 mpg instead of 40 mpg _____ gallons _____ dollars

28. 50 mpg instead of 45 mpg _____ gallons _____ dollars

1.7 In which two ways do power options cut gas mileage? 29. ____________________

1.7 In a small car, which takes more power: driving with the windows down or using the air conditioner? 30. ____________________

1.7 What happens to power requirements when power equipment is added to a given vehicle? 31. ____________________

1.7 How should one determine if power equipment is needed on a vehicle? 32. ____________________

1.8 In which respect do American cars outperform imports? 33. ____________________

1.8 List two disadvantages of small cars. 34. ____________________

____

1.8 In small car-truck crashes, who is most frequently killed? 35. ____________________

1.8 List two things that can make travel in small cars safer. 36. ____________________

____

Learning Aid

Iowa Energy Project

Dollar-Saving Ideas For Fuel-Efficient Drivers

Vehicle Selection

1.1	How might "two-car" owners solve the dual problem of heavy loads on one hand and moving a single person on the other?	1. One large and one small car
1.1	Is it possible for a low-mileage driver to quickly regain the cost of a new small car with fuel savings?	2. No
1.2	Which size vehicle is able to carry extra weight without a serious reduction in gas mileage?	3. Large
1.2	Are all compact cars alike in cargo space?	4. No
1.2	What effect does weight have on rolling resistance?	5. Increases
1.3	At what speed does air drag begin to be important?	6. 35 mph
1.3	At 55 mph, what percentage of your power is needed to overcome air drag?	7. 60 percent
1.3	Is air drag important at city speeds?	8. No
1.4	What is the effect of a small engine in a heavily loaded car?	9. Burns more gas
1.4	In the spaces to the right, match the ideal engine size to the vehicles listed.	10. Compact - four-cylinder
		11. Mid-size - six-cylinder
		12. Full-size - eight-cylinder
1.4	How much more fuel economy should you expect from a diesel engine?	13. 20 to 35 percent
1.4	List two advantages of diesel engines.	14. Better in short trips, low speeds and stop-go traffic Longer range per tank
1.4	If you usually carry four people in a small car, what size engine would be best?	15. Four or six-cylinder
1.4	What happens to gas mileage when larger engines are installed in a vehicle?	16. Goes down
1.5	Are five-speed transmissions always more economical than four-speed transmissions?	17. No
1.5	Should one automatically assume that buying a manual shift will guarantee better gas mileage?	18. No

1.5	Why is an overdrive not cost-effective in city traffic?	19. Cannot be used there
1.5	Should an owner expect greatly higher gas mileage from an overdrive?	20. No
1.6	Does buying a small car always mean that it will be economical on fuel?	21. No
1.6	Is it possible to buy a mid-size car that will give better gas mileage than a sub-compact?	22. Yes
1.6	Do you suspect that an American mid-size would provide better protection than would an imported sub-compact?	23. Yes

1.6 Refer to the chart on page 7 . How many gallons and how many dollars can be saved by driving a vehicle that produces five mpg better fuel economy?

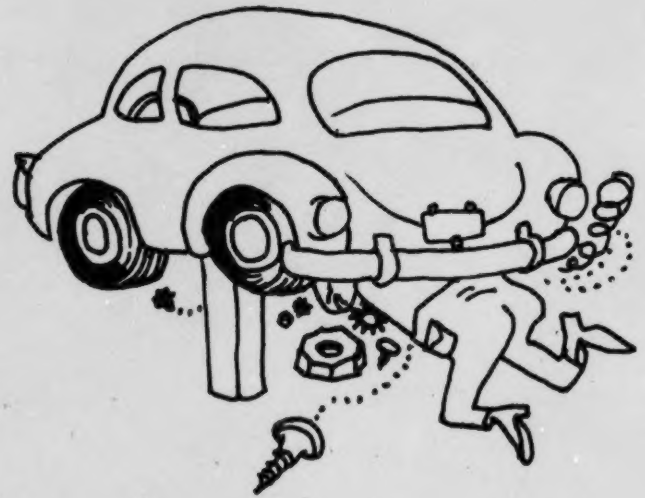
24.	15 mpg instead of 10 mpg	334	gallons	400	dollars
25.	25 mpg instead of 20 mpg	100	gallons	120	dollars
26.	35 mpg instead of 30 mpg	47	gallons	56	dollars
27.	45 mpg instead of 40 mpg	28	gallons	36	dollars
28.	50 mpg instead of 45 mpg	22	gallons	26	dollars

1.7	In which two ways do power options cut gas mileage?	29. Weight and power
1.7	In a small car, which takes more power, driving with the windows down or using the air conditioner?	30. Air conditioner
1.7	What happens to power requirements when power equipment is added to a given vehicle?	31. Go up
1.7	How should one determine if power equipment is needed on a vehicle?	32. TEST DRIVE!
1.8	In which respect do American cars outperform imports?	33. Crash protection
1.8	List two disadvantages of small cars.	34. Break-away poles don't break Weight cuts gas mileage more
1.8	In small car-truck crashes, who is most frequently killed?	35. Small car occupants
1.8	List two things that can make travel in small cars safer.	36. Fasten restraints Concentrate. Keep your car out of the way.

Test - Vehicle Selection

Answers are on page 9

1. Selection of a vehicle should depend most on . . .
   - a. The largest load you may need to carry.
   - b. Once-a-year vacation needs.
   - c. Average daily needs.
   - d. A top gas-mileage rating.
2. In which size vehicle does gas mileage go down most when weight is added?
   - a. Sub-compact
   - b. Compact
   - c. Mid-size
   - d. Full-size
3. A large frontal area is the greatest problem . . .
   - a. At highway speeds.
   - b. When carrying a load.
   - c. Below 35 mph.
   - d. Away from hard surfaces.
4. In a compact car, under normal conditions, which engine will produce the best gas mileage?
   - a. Four-cylinder
   - b. Six-cylinder
   - c. Eight-cylinder
5. An important advantage of a diesel engine is . . .
   - a. Greater fuel economy.
   - b. Faster acceleration.
   - c. Quieter operation.
   - d. All of these.
6. A comparison between stick and auto shifts shows that . . .
   - a. The stick shift is always more economical.
   - b. Auto shifts are always more economical.
   - c. Some auto shifts are more economical.
7. Overdrive transmissions are more effective . . .
   - a. At highway speeds.
   - b. In hilly country.
   - c. Pulling a trailer.
   - d. In city traffic.
8. Which of these statements about gas mileage is true?
   - a. All sub-compacts get better gas mileage than do compacts.
   - b. All compacts get better gas mileage than do mid-size cars.
   - c. Some larger cars get better gas mileage than do some smaller cars.
   - d. All of these.
9. Which of the following will result in the *smallest increase* in dollar savings?
   - a. 15 mpg instead of 10
   - b. 25 mpg instead of 20
   - c. 35 mpg instead of 30
   - d. 45 mpg instead of 40
10. When you add power equipment to a vehicle . . .
    - a. Added weight takes more power.
    - b. A larger engine could become necessary.
    - c. Small cars will be affected more.
    - d. All of these.



Vehicle Maintenance

Vehicle Maintenance

2.0 Vehicle Maintenance

Some vehicles are overmaintained. Some are undermaintained. Both waste energy and money. The trick is to do exactly what should be done when it is supposed to be done.

2.1 Keep Records

Records help you to understand the gas mileage you are getting. Records also help you to keep track of maintenance needs and costs.

2.2 Owner's Manual

Your owner's manual is a guide to fuel-efficient and economical driving.

2.3 Tune-ups

It is difficult to regain the cost of a tune-up in fuel savings. Get the opinion of an expert before you spend $75 to $100 for a complete tune-up.

2.4 Filters

Scare advertising causes some people to change filters too frequently. Indifference and ignorance cause some to wait too long.

2.5 Oil

When selecting an oil, be sure that you will be able to regain the added cost in fuel savings when you buy super grade products.

2.6 Cooling System

Few people suspect that a malfunctioning cooling system can drastically cut gas mileage.

2.7 Tires

Tires are the most neglected part of a car. Underinflated tires cut fuel economy, increase wear and make handling more difficult.

2.8 Fueling Your Car

How you fuel your car can determine if you will waste or save money before you have driven a single mile. It will pay to know all about fueling.

2.9 Gadgets and Fluids

As fuel prices rise, quick-buck artists are ready to take advantage of a motorist who will do anything to go farther on a gallon of fuel.

2.0 Vehicle Maintenance

Objective:

Hold costs for fuel and maintenance to the lowest practical level.

2.1 Keep Records

Objective:

Take a systematic approach to holding transportation costs to a minimum.

A. Maintenance records will help you to do the following:

1. Be sure when service is needed.
2. Prevent repeating service that has been performed.
3. Determine the cost of ownership.
4. Prevent neglect or oversight of important maintenance tasks.

B. Gas mileage records

1. Record miles driven, gallons used, miles per gallon and cost.
2. This can help you to determine if a tune-up is needed. Compare mileage with other persons with an identical vehicle.
3. Do not judge by one tank of fuel. Long-term records are needed.
4. Do not look at fuel costs only when evaluating cost of transportation.

C. Trip or vehicle-use records

1. Record vehicle temperature, air temperature, length of trip, and load, as well as road and traffic conditions because these are important influences on fuel economy.
2. The above could readily account for a sudden drop in fuel economy. *Example:* You are taking short drives on hilly, snow covered roads with very cold temperatures. Normal mileage for a full size V-8 might be as low as four to five miles per gallon under these conditions.
3. *Note*—Driver habits also have a strong influence on gas mileage. If you get poor mileage under favorable conditions, it could be due to driving habits, a vehicle badly out of tune or both.

2.2 Owner's Manual

Objectives:

Conserve energy by preventing premature wear-out of vital parts and components.

Conserve fuel by performing required maintenance tasks at the right time.

A. Follow your owner's manual for maintenance intervals.

B. How an owner's manual can help you:

1. Owner's manual tells you how to properly operate your vehicle for maximum fuel economy.
2. Owner's manual provides maintenance charts that give exact intervals at which service is to be performed.
3. Be sure to make exceptions for short drives, extreme temperatures, and dusty conditions.
4. If your car does not have an owner's manual, get one at your dealer or salvage yard.

2.3 Tune-up

Objectives:

Maintain your engine so that it will produce all the power it was designed to deliver.

Have an engine that will start and run dependably as well as economically.

Minimize fuel and maintenance costs.

A. When is a tune-up necessary?

If your car starts well, runs smoothly, does not cough or backfire, and accelerates smoothly without hestitation, you should not need a tune-up.

B. Is a diagnostic center a good idea?

Yes, a diagnostic center can give you a good idea of what needs to be done. Often adjustments are all that are needed to improve performance and fuel economy.

C. How much money will a tune-up save?

How much depends on two important factors: the cost of the tune-up and how much improvement was made.

1. Department of Transportation evaluation - "You're not likely to save enough gasoline to pay for a full tune-up, but you need occasional tune-ups to keep your car running well, and increased gas mileage is an added benefit . . . it is reasonable to expect a three percent average improvement right after a tune-up. The average driver who spends $1,000 a year on gas, should save about $15 from an annual tune-up."
2. If an owner with electronic ignition habitually had a tune-up each year (10,000 miles), it would be impossible to gain back the cost in fuel savings.
3. Gas savings are not the only reason for a tune-up. Reliable starting and dependable performance have a positive value that cannot be measured in dollars.
4. Conclusion: An expensive tune-up with a moderate gain in gas mileage can never be paid for with fuel savings. How much can be gained from a tune-up depends on how badly mileage had declined in the first place.

D. What should be done to the carburetor?

1. Do not tamper with *emission devices*. Removing or changing one part affects everything else.

2. Be sure the *automatic choke* is working properly. If black smoke comes out the of exhaust pipe, chances are the choke needs adjustment.

3. Fast-idle speed should not be too fast. If your car runs more than 15 to 20 mph without any accelerator pressure, it could be set too high and be wasting fuel.

2.4 Filters

Objectives:

Avoid changing filters too frequently.

Avoid running filters too long.

A. Follow your owner's manual for filter change intervals.

B. Air Filters

1. "Pay me now or pay me later." What is the truth? The truth is that some owners change filters long before change is needed. A few mechanics are motivated by profits to replace your filter before it is necessary.
2. General Motors recommends a 30,000-mile interval except in dusty areas.
3. McDonnell-Douglas applied segments of foil over an air filter and reached the 87 percent level before the engine began to slow down. The engine did not consume extra fuel.
4. As a filter collects dirt, it becomes more efficient.
5. Test your filter by holding a flashlight or trouble light up inside it. If you can see light, it is still serviceable.
6. Precautions:
    a. Be sure that the bottom of the air cleaner housing is clean and free of gravel to permit an airtight seal.

    b. Never use an air hose to blow dust out of a filter. Holes can be blown into the paper.

    c. Never tap a filter on a solid surface to knock the dirt out.

    d. A vacuum cleaner can be used to draw dust deposits from your filter.

    e. Rotate your filter slightly to move a dirty section away from the intake.

C. Oil Filters

1. Most manufacturers recommend a 7,500-mile change interval under ideal conditions. This would include warm weather, long drives, and clean air.
2. Saw the cover off a used filter and inspect it for sludge and other deposits.
3. Filters removed from summer and winter driving looked clean after 2,500 and 5,000 miles (project tests).
4. If you change oil but not the filter, remove filter, pour out old oil, and reinstall.

D. Fuel Filters

1. An engine will stop running when the fuel filter becomes clogged.
2. The outside of a paper filter will look good when the inside is clogged with dirt.
3. If you can blow air through a filter, it is probably serviceable.

2.5 Oil and Energy Conservation

Objectives:

Do not waste oil by changing it too often.

Use the right grade of oil to maximize fuel economy.

A. Follow your owner's manual as to oil change intervals and grade of oil.

B. Oil Changes

Oil change intervals depend on temperature, length of trip, dust, and effectiveness of the air filter.

Oil usually becomes dirty or contaminated before it wears out or loses lubricating qualities.

C. Cold Temperature Operation

Length of trip and number of short trips taken influence the useful life of oil.

Cars warm up slowly in cold weather.

1. At the end of the first mile at 15 degrees with 1978 Chevrolet, some heat was beginning to come from the heater. Oil on the dip stick felt cool but not cold.
2. At two miles oil began to feel warm.
3. At three miles oil was almost hot.
4. At four miles the oil was too hot to touch. If the trip were ended here, there would be no chance of getting rid of any contaminants. Oil change intervals must be shorter in trips of four miles or less (See owner's manual).

D. Electric Engine Heater

An electric engine heater should reduce warm-up time, improve fuel economy, and reduce oil contamination. Do not run block heater overnight except where required with diesels.

E. Synthetic Oils

Synthetic oils and additives known as friction modifiers generally provide three to seven percent improvement in fuel economy. The problem with these oils is that they can become contaminated before they reach the payback point in winter.

F. Gas Saving Oils

Gas saving oils cost more but allow extra gas mileage.

G. Oil Change Intervals

Some manufacturers recommend a 7,500-mile oil change interval. This should only be done under warm engine temperatures and long trips.

H. Oil Weights

Multigrade oils such as 10W-30 and 10W-40 are preferable to single-grade oils under most conditions.

Use 5W oil only if approved in owner's manual.

5W oil should not be used on long trips or in warm weather. Damage to the engine is likely to result.

I. Do-It-Yourself

You can save money by working on your own car. If you do, please take these precautions:

1. Never work under a jacked up car without some kind of solid support for the vehicle should the jack fail or tip.
2. Know exactly what must be done and how to do it.
3. Shop manuals are available for each type of vehicle.
4. You must have the right equipment for the job.

J. Engines that are prematurely worn out due to neglect waste energy. A great deal of energy is needed to produce repair parts.

2.6 Cooling System

A. Small engines in small cars tend to warm up very slowly.

B. Cover the radiator in very cold weather to quicken warm-up.

C. If you cover the radiator, be sure to remove it for longer drives or warmer temperatures.

D. If you get no heat from the heater, the thermostat could be stuck open. The engine will not warm up, resulting in poor performance and poor gas mileage.

E. In cold weather, place an old coat or blanket over the grill to reduce cool-down between trips.

2.7 Tires

Objective:

Maintain your tires for maximum fuel economy and minimum wear.

A. Inflation

1. Check tire pressure each week.
2. Inflate all tires to pressure shown in owner's manual or on car.
3. Check tires for wear, make a walk-around inspection before each drive.

4. Air pressure drops one pound for each 10-degree temperature drop. Watch this at onset of winter weather.

5. Don't nurse slow leaks by adding air periodically. Move car slowly and inspect tread for nails. Check valve for leak.

B. Inspection

1. To check for misalignment, rub palm of hand across face of tire. If you feel sharp edges, wheel could be out of alignment.

2. Drive at highway speed with no wind. Car should run in straight line without having to hold steering wheel to right or left.

3. Look for worn spots that can be caused by a tire being out of balance.

4. Bounce the corner of your vehicle. It should settle down without bouncing up and down several times. If not, new shock absorbers are indicated.

5. Check sidewalls for cracks and bulges.

6. Measure tread depth with depth gauge. Center wear indicates overinflation; wear on outside of tread indicates underinflation.

C. Tires for rain and snow

1. Radial "all-weather" tires are a good way to provide rain and snow traction without having the problem of installing and removing snow tires.

2. Do not put snow tires on before you need them. Remove them as soon as weather warms up in spring.

3. Do not store snow tires in the trunk of the vehicle because each 100 pounds of added weight increases fuel consumption by one percent.

D. Energy Conservation

A tire that is prematurely worn out is a waste of oil because oil and energy are needed to manufacture and transport tires.

E. Replacement of tires

1. Extra-wide tires take more fuel than the tire size normally used on a given vehicle.

2. Use long stems instead of extenders, which tend to leak. Screw-on caps are less likely to leak.

F. Goodyear - - - "Rotate tires every 6 to 8,000 miles. Life will be extended 20 percent."

2.8 Fueling Your Vehicle

Objectives:

Learn fueling techniques that will prevent spills and overflow.

Learn which fuel is best for your car.

Learn how to compute miles per gallon.

A. Cap and filler neck

1. Buy a locking gas cap to prevent theft and vandalism. The wrong kind could cause gas tank to collapse or engine to stall.
2. Check sealing gasket on gas cap to prevent leaking and evaporation.

B. How to fill:

1. Turn off engine while fueling vehicle.
2. Estimate number of gallons needed for fill so you can reduce flow rate near the "full" point.
3. Self-service saves money and can prevent spills.
4. If automatic shut-off stops flow before full:
   a. Nozzle may be too far into filler neck.
   b. Nozzle may not be straight with filler neck.
   c. Flow rate could be too fast.
5. Gradually increase flow rate to level where pump will stay running.
6. Stay with vehicle in case nozzle falls out of neck.
7. Reduce flow rate as you near estimated number of gallons needed to fill. Listen for gurgle. Have passenger watch fuel gauge and advise you.
8. Do not top off tank. Fuel could expand in hot weather. With older cars, fuel could run out if you park uphill.
9. Tilt hose to get all the fuel you paid for.
10. Diesel fuel foams when pumped rapidly. Reduce flow rate to keep automatic shut-off from stopping before tank is full.
11. Be sure cap is tight. If not, fuel may run out of tank when accelerating.

C. When to fuel:

1. In winter keep tank above half full to prevent condensation in the fuel tank.
2. Fuel weighs about six pounds per gallon. In warm weather, avoid filling before the one-quarter full mark.

D. Where to fuel:

1. Do not make a special trip to fuel your vehicle. Check prices as you drive for other reasons.
2. Shop for best prices. Leave the interstate to buy fuel when traveling.

E. What kind of fuel to use:

1. Do not put leaded fuel into a vehicle requiring unleaded fuel. Emission control components will be damaged. Spark plugs will foul more quickly.
2. Do not use premium fuel if your vehicle operates well without it. If your vehicle pings or runs on after turning it off, try another brand of fuel when the tank is near empty.

3. A vehicle that needs premium fuel in the city may not require it on country highways that are relatively level.

4. A lower octane fuel works well in the mountains because the higher the altitude, the lower the octane needed.

5. Gasohol runs cleaner and has a higher octane.

6. Older engines with larger amounts of combustion deposits require a higher octane.

F. Computing Gas Mileage

1. Fill to the same level each time.

2. To get "mpg", divide gallons used into miles driven. Divide 10 gallons into 200 miles = 20 mpg.

3. A drop in mpg could indicate the need for a tune-up if other conditions remain constant.

4. Be sure driving style or driving conditions did not cause a drop in mpg.

2.9 Gadgets and Fluids

Objective:

Critically examine all advertisements of magic fluids and super gadgets that claim dramatic gains in fuel economy.

A. United States government tests have failed to find a single gadget that improves fuel economy enough to pay for itself in a reasonable length of time.

B. Example: "Cow Magnets," which were claimed to improve gas mileage up to six miles per gallon, were found to be ineffective in a 1978 Chevrolet project vehicle. Gas mileage over 100 miles at 50 mph remained at 20 miles per gallon. Instruments used -"Flow Scan" that measured fuel in 1/1000 of a gallon and "Trip Master" that measured distance in 1/1000 mile.

C. Beware of customer endorsements. The average driver cannot conduct a test where all factors operate equally in a "before" and "after" test.

D. Be sure that your vehicle warranty will be valid if you add some kind of fluid or device.

E. Octane improvers do raise the octane of fuel, but the results are not great enough to pay for the cost of the additive. Use gasohol to raise octane level.

F. When drivers add some kind of device:

1. Gas mileage may improve from "adjustments" required by installation directions.

2. Drivers tend to drive better to gain more miles per gallon.

Vehicle Maintenance

1. Keep records
2. Follow owner's manual for schedule
3. Set idling speed at lowest practical level
4. Check tire pressure each week
5. Align and balance wheels
6. Use care when fueling

True/False Exercise — Vehicle Maintenance

1. A sudden drop to poor gas mileage usually means you need a tune-up.
2. The main reason for keeping records is to determine costs.
3. An owner's manual is an important part of a maintenance program.
4. If your engine starts well and runs smoothly, it should not need a tune-up.
5. When a car uses too much oil, black smoke comes out the exhaust pipe.
6. When an air filter looks dusty on the outside it should be changed.
7. Tire pressure drops one pound for each 10 degree temperature drop.
8. To get miles per gallon, divide gallons into miles.
9. When you fuel your car it is best to fill it to the rim.
10. As a new air filter collects dust, gas mileage goes down.

True/False Feedback — Vehicle Maintenance

1. F First check traffic, weather, terrain, and how you drove. It takes more than a single tank of fuel to check fuel economy.
2. F The main reason for keeping records is to prevent over-maintenance as well as under-maintenance.
3. T The owner's manual tells you how to operate and maintain your vehicle. You can't get top economy in a vehicle you do not fully understand.
4. T With electronic ignition, a tune-up should not be needed before 20,000 miles. Frequently, only adjustments are needed.
5. F Black smoke comes from gasoline. A choke could be stuck. Fix it promptly.
6. F GM recommends 30,000 miles between filter changes. If you can see light from a trouble light through the filter element, it is usually still good.
7. T Check tires more frequently when temperatures slip downward in the fall.
8. T If you drive 200 miles on 10 gallons of fuel, your rate is 20 miles per gallon.
9. F The least that can happen is that it would run over. You could also lose fuel if it warms and expands and runs out of the charcoal filter.
10. F Up to a point, the more dust it collects, the better it filters. It is doubtful that a dirty filter will cut gas mileage. The engine will slow down and lose power before a choking action will occur.

Dollar-Saving Ideas For Fuel-Efficient Drivers

Vehicle Maintenance

2.1	Give two ways keeping maintenance records can help you.	1. ____________________ ____________________
2.1	What is the value of gas mileage records?	2. ____________________
2.1	Why should one not base tune-up decisions on one tank of fuel?	3. ____________________
2.1	What effect does cold weather have on gas mileage?	4. ____________________
2.1	What could be two reasons for poor gas mileage under good driving conditions?	5. ____________________ ____________________
2.2	List two important kinds of energy-saving information that can be gained from your owner's manual.	6. ____________________ ____________________
2.2	Give three exceptions to normal maintenance intervals listed in an owner's manual.	7. ____________________ ____________________ ____________________
2.3	List four indicators that might tell you a tune-up is needed.	8. ____________________ ____________________ ____________________ ____________________
2.3	Instead of a tune-up, what is a less expensive way to improve performance?	9. ____________________
2.3	How much money you can save with a tune-up depends on . . .	10. ____________________
2.3	In addition to fuel savings, list two values of a tune-up.	11. ____________________ ____________________
2.3	The DOT evaluation indicates a $________ per year fuel saving from a tune-up.	12. ____________________
2.3	What is the cause of black smoke from the exhaust pipe?	13. ____________________
2.4	Under what condition should an air filter be changed more often?	14. ____________________

2.4 What happens to air filter efficiency as it collects dirt? 15. ____________________

2.4 List two things you should not do to an air filter. 16. ____________________

____

2.4 How should one decide if an air filter is still good? 17. ____________________

2.4 List three conditions that must be met if you drive 7,500 miles on one oil filter. 18. ____________________

____

____

____

2.5 If winter trips are less than four miles long, what should you do about oil changes? 19. ____________________

2.5 Under what conditions could thin oil (5w) damage an engine? 20. ____________________

____

2.5 If you jack up a car to change oil, what precaution should be taken? 21. ____________________

2.5 In what way are worn-out auto parts a waste of energy? 22. ____________________

2.6 What is indicated when an engine will not warm up enough to get heat from the heater? 23. ____________________

2.6 List two conditions under which the engine could be damaged by driving with the radiator covered. 24. ____________________

____

2.7 How often should one check tire pressure? 25. ____________________

2.7 Where can one find the best guide for tire pressure? 26. ____________________

2.7 During what season does tire pressure drop rapidly? 27. ____________________

2.7 How much does tire pressure drop for each 10 degree temperature drop? 28. ____________________

2.7 List four different ways to check tires. 29. ____________________

____

____

____

2.7 What is the result of storing snow tires in the vehicle trunk? 30. ____________________

2.7 What effect do wider tires have on gas mileage? 31. ____________________

2.7 According to Goodyear, how much might rotating extend tire life? 32. ____________________

2.8 What is indicated when fuel begins to gurgle while fueling? 33. ____________________

2.8 Give two disadvantages of "topping of a tank" when fueling. 34. ____________________

____

2.8 Why is filling to the same level important when figuring mpg? 35. ____________________

2.8 To get miles per gallon, divide ______ into ______. 36. ____________________

2.8 What is the advantage of a full tank of fuel in winter? 37. ____________________

2.8 Why does a full tank of fuel cut gas mileage? 38. ____________________

2.8 Why should one not use premium fuel in the mountains? 39. ____________________

2.8 Give two advantages of "self-serve" fueling. 40. ____________________

____

2.9 What is the government's assessment of most "fuel-saving" gadgets and liquids? 41. ____________________

Learning Aid

Iowa Energy Project

	Dollar-Saving Ideas For Fuel-Efficient Drivers	Vehicle Maintenance
2.1	Give two ways keeping maintenance records can help you.	1. Know when service is needed Know cost of ownership
2.1	What is the value of gas mileage records?	2. Know when tune-up is needed
2.1	Why should one not base tune-up decisions on one tank of fuel?	3. Too small to be accurate
2.1	What effect does cold weather have on gas mileage?	4. Goes down
2.1	What could be two reasons for poor gas mileage under good driving conditions?	5. Short drives Your driving habits
2.2	List two important kinds of energy-saving information that can be gained from your owner's manual.	6. How to drive Maintenance schedule
2.2	Give three exceptions to normal maintenance intervals listed in an owner's manual.	7. Short drives Dusty conditions Extreme temperatures
2.3	List four indicators that might tell you a tune-up is needed.	8. Poor gas mileage Misfires Hestitates Runs rough
2.3	Instead of a tune-up, what is a less expensive way to improve performance?	9. Simple adjustments
2.3	How much money you can save with a tune-up depends on . . .	10. How badly the engine ran
2.3	In addition to fuel savings, list two values of a tune-up.	11. Reliable starting Dependable performance
2.3	The DOT evaluation indicates a $______ per year fuel saving from a tune-up	12. $15
2.3	What is the cause of black smoke from the exhaust pipe?	13. Choke stuck

2.4	Under what condition should an air filter be changed more often?	14.	Dusty
2.4	What happens to air filter efficiency as it collects dirt?	15.	Goes up
2.4	List two things you should not do to an air filter.	16.	Air blast Knock dirt out
2.4	How should one decide if an air filter is still good?	17.	Light test
2.4	List three conditions that must be met if you drive 7,500 miles on one oil filter.	18.	Warm temperature Long drives Clean air
2.5	If winter trips are less than four miles long, what should you do about oil changes?	19.	Change more often
2.5	Under what conditions could thin oil (5w) damage an engine?	20.	Long drives Warm temperature
2.5	If you jack up a car to change oil, what precaution should be taken?	21.	Solid support
2.5	In what way are worn-out auto parts a waste of energy?	22.	It takes energy to make them
2.6	What is indicated when an engine will not warm up enough to get heat from the heater?	23.	Thermostat stuck open
2.6	List two conditions under which the engine could be damaged by driving with the radiator covered.	24.	Warm weather Long drive
2.7	How often should one check tire pressure?	25.	Each week
2.7	Where can one find the best guide for tire pressure?	26.	Owner's manual
2.7	During what season does tire pressure drop rapidly?	27.	Winter
2.7	How much does tire pressure drop for each 10 degree temperature drop?	28.	One pound
2.7	List four different ways to check tires.	29.	Visual Tire gauge Run palm across tread Depth gauge

2.7	What is the result of storing snow tires in the vehicle trunk?	30. Weight cuts mpg
2.7	What effect do wider tires have on gas mileage?	31. Reduce it
2.7	*According to Goodyear, how much might rotating extend tire life?*	32. 20 percent
2.8	What is indicated when fuel begins to gurgle while fueling?	33. Nearing "full"
2.8	Give two disadvantages of "topping of a tank" when fueling.	34. Overflow while fueling Heat expands and overflows
2.8	Why is filling to the same level important when figuring mpg?	35. Influences mpg
2.8	To get miles per gallon, divide _______ into ______.	36. Gallons - miles
2.8	What is the advantage of a full tank of fuel in winter?	37. Less condensation
2.8	Why does a full tank of fuel cut gas mileage?	38. Extra weight
2.8	Why should one not use premium fuel in the mountains?	39. Not an advantage
2.8	Give two advantages of "self-serve" fueling.	40. Lower cost Fewer spills
2.9	What is the government's assessment of most "fuel-saving" gadgets and liquids?	41. They don't work

Answers for page 35

1. c (2.3) 2. c (2.3), 3. c (2.5), 4. a (2.7), 5. b (2.7), 6. a (2.7), 7. b (2.7), 8. a (2.8), 9. d (2.8), 10. d (2 .8)

Test - Vehicle Maintenance

Answers are on page 34

1. Which of the following indicate that too much gasoline is being burned?

   a. White exhaust vapor
   b. Blue exhaust smoke
   c. Black exhaust smoke

2. Which is the best reason for a tune-up?

   a. Winter is coming
   b. Annual vacation trip
   c. Engine runs rough
   d. One year since the last one

3. How can one determine when to change an air filter?

   a. How long it has been in use
   b. How many miles it has been used
   c. Hold a light inside the filter element
   d. The color of the outside of the element

4. When are tires most likely to become underinflated?

   a. Going from fall to winter
   b. Going from winter to spring
   c. Going from spring to summer
   d. After a 500-mile drive

5. Which of these should not be done to an air filter element?

   a. Rotate it a half turn after 5,000 miles
   b. Blast it clean with an air hose
   c. Run it farther than the oil filter
   d. Keep in use for longer than a year

6. How often should tire pressure be checked?

   a. Each week
   b. Each month
   c. When you change oil
   d. Spring and fall

7. Which will give you the best gas mileage?

   a. Snow tires
   b. Radial tires
   c. Bias ply tires

8. When fueling your car, which should you NOT do?

   a. Fill it to the brim
   b. Stop when the nozzle shuts off
   c. Gradually increase rate of flow at first
   d. Fill to the same level each time

9. To calculate miles per gallon you must . . .

   a. Subtract (gallons from miles)
   b. Multiply (gallons times miles)
   c. Add (gallons to miles)
   d. Divide (gallons into miles)

10. Which of these is not a good idea?

   a. Premium gas in the mountains
   b. Regular gas when your engine knocks
   c. Leaded gas in a new car
   d. All of these

Vehicle Operation

Vehicle Operation

3.0 Vehicle Operation

Gain the maximum amount of useful work from each gallon of fuel.

3.1 Human Factors

Drivers have more influence on gas mileage than any other single factor. The cost of fuel is the same for everyone. The cost per mile is up to you.

3.2 Starting the Engine

Minimize the number of cold starts.

3.3 Idling

Reduce your engine's idling speed to the lowest practical level.

3.4 Acceleration

Accelerate gradually for top fuel economy.

3.5 Speed

Drive at a steady speed in or near the ideal range of 30 mph.

3.6 Communication

Communicate for all maneuvers to help other drivers save fuel.

3.7 Driver Actions

Your actions influence fuel economy, affect others, and determine how safe you will be.

3.8 Decelerating, Stopping, and Turning Off the Engine

Stop feeding gas well in advance of turns and stops to exploit the momentum you have built up.

3.9 Stick Shift

Shift at the best speed for each gear. Avoid large gas pedal movements.

3.0 Vehicle Operation

Objectives:

Minimize the number of engine revolutions per trip.

Do not feed more gas than your engine can efficiently use.

3.1 Human Factors

The driver has more influence on gas mileage than any other single factor.

A. Knowledge

You cannot be a fuel-efficient driver in environments and vehicles you do not fully understand.

B. Concentration

Concentration is needed to apply knowledge and to employ fuel-saving strategies.

C. Motivation

To be a fuel-efficient driver, you must want to extract the maximum amount of mileage out of each gallon of fuel.

Twenty-five dollars for a tank of fuel should give you strong motivation to learn everything possible about maximizing fuel economy.

D. Skill

A skillful person-to-machine match-up is crucial to extracting all the mileage your vehicle has been designed to deliver.

E. Vehicle Choice

The vehicle you buy and why you bought it. can strongly influence how you drive it. The driver of a small "person mover" will probably exhibit a more conservative style than the driver of a high-powered sports car.

A car is not a toy and a street is not a playground!

F. Trip Purpose

Your reason for driving can also have a strong influence on fuel economy. Drivers who drive for emotional outlet, ego extension, and pleasure purposes may lack motivation needed for maximum mpgs.

3.2 Starting the Engine

Objectives:

Minimize the amount of fuel used during start-up.

A. You can waste fuel starting an engine if:

1. You start the engine and wait for passengers.

2. You pump the gas pedal several times while starting.
3. You feed gas to start a warm engine.
4. You race the engine to hasten warm-up.

B. Follow your owner's manual.

Starting procedures can vary widely from model to model.

C. Experiment.

Try to start your car with the least amount of pumping.

D. Minimize the number of times you start your engine. Ninety-five percent of all wear occurs in the first 10 seconds of cold operation.

3.3 Idling

Objectives:

Hold down the amount of avoidable idling.

A. A standing warm-up wastes fuel.

1978 Chevrolet 305 V-8

Five-minute standing warm-up uses .136 of a gallon of fuel.

Start it, wait a few seconds, then drive it. Ninety-five percent of all wear during a cold start takes place in the first 10 seconds of operation.

B. How to check idling speed:

1. Idling speed determines how much fuel is burned while decelerating and standing.
2. Failure to turn right on red could burn enough fuel to go about two blocks.
3. Fifteen to 18 miles per hour is much too fast an idle in a warmed-up car.
4. If your engine runs on after it is switched off, idling speed could be too high.

C. Idling and vehicle operation:

1. If it appears that you will be standing for more than a minute, turn off the engine.
2. Promptly turn off the engine when you reach your destination.
3. Jab gas pedal down to cut fast idle as engine warms up.

3.4 Acceleration

Objectives:

Feed only as much fuel as your engine can efficiently use.

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A. Vacuum Gauge

A vacuum gauge is an inexpensive instrument that can be used to indicate wasteful pedal action.

B. Ease into motion

Don't jerk your car into motion. Ease it into motion.

C. Not too slow and not too fast

Accelerating too slowly causes you to stay in lower gears too long. Accelerating too fast wastes fuel.

D. Sudden, hard acceleration

Pushing the gas pedal abruptly downward causes the acceleration pump as well as the power valve to go into operation. Gas mileage under this condition is about three to seven miles per gallon in a large car.

Zero to 30 mph Acceleration Test

1978 Chevrolet

Type	DISTANCE	TIME	FUEL	MPG
Gradual	.10	17 sec.	.011	9.09
Brisk	.10	16 sec.	.012	8.33
Rapid	.10	15 sec.	.014	7.14

Accelerate gradually. Rapid acceleration saves only two seconds but takes nearly 25 percent more fuel.

E. Passing

When safe, avoid using passing gear. Do not build a greater speed advantage than is needed.

F. Vacuum levels and shifting

Hard acceleration drops the vacuum level in the engine. This vacuum drop delays shifting to second and third gears because most automatic transmissions use vacuum to shift.

G. When to delay shifting

Delayed shifting is sometimes desirable:

1. While heavily loaded.
2. When starting up a hill.
3. For added rolling resistance in mud, sand or snow.
4. When accelerating into a strong wind.
5. While running the air conditioner.
6. Under combinations of any of the above conditions.

3.5 Speed and Gas Mileage

Objectives:

When safe, legal and practical, drive in or near the ideal speed range (30 to 45 mph).

Try to drive at an even speed whenever possible.

Drive at the speed of most other vehicles around you.

A. Ideal speed

The ideal speed for best gas mileage is about 30 to 35 mph for most cars. Under 30 mph, rolling resistance of the vehicle reduces gas mileage. At about 35 mph, air resistance begins to cut gas mileage.

The further you get away from the ideal speed bracket (upward or downward), the poorer the gas mileage.

Some lockup transmissions produce the same gas mileage at 35 to 45 mph.

B. Speed :: Time Saved (large car)

INCREASE	SAVED PER MILE
50 to 55 mph	6.6 sec.
55 to 60 mph	5.4 sec.
60 to 65 mph	4.7 sec.
65 to 70 mph	3.9 sec.

1. Note how gains become smaller at higher speeds.
2. A test of 10 compact and sub-compact cars showed an average of 15 percent decrease in gas mileage when cars were driven 65 mph instead of 55 mph.

3.6 Communicating in Traffic

Objectives:

Show signals to help improve traffic flow.

A. Left turns

1. When planning a left turn, signal so that oncoming drivers intending to turn left can turn when you do.
2. Drivers following will be able to go around you with a minimum speed loss.

B. Right turns

1. Signal for right turns so that drivers to your right stopped at signals may use the gap that your turn will create.
2. Drivers following may go around you with minimum speed loss.

3.7 Control Actions

Objectives:

Maximize fuel economy by avoiding unnecessary control movements.

A. Steering wheel movements affect fuel economy.

B. Check yourself for "nervous foot." This has a direct effect on fuel consumption.

C. Be sure car is in *drive*. In most cars it is difficult to tell by sound that the vehicle is in D-2.

D. Be sure parking brake is off. Even if it is dragging lightly, fuel consumption is affected.

E. Avoid braking with the left foot while you feed gas with the right foot.

3.8 Decelerating, Stopping and Turning Off the Engine

Objectives:

Minimize the number of revolutions during these activities.

Exploit momentum you have built up.

A. Look way ahead (30 to 45 seconds) for traffic lights, stop signs, or traffic tie-ups. Promptly quit feeding gas when it appears you must stop. Most drivers wait too long to quit feeding gas. Hard stops slosh fuel out of the carburetor and flood engine which causes wasted fuel.

B. If you brake firmly in such instances, it could indicate that you waited too long to cut the power.

1976 Buick Le Sabre	350 V-8	Level Road
Steady 30 mph		.030 gal. per minute
Coast in drive		.012 gal. per minute
Coast in neutral		.017 gal. per minute

(321.365 Coasting Prohibited *Iowa Motor Vehicle Code*)

1. The driver of any motor vehicle, when traveling on a downgrade, shall not coast with the gears of such vehicle in neutral.

2. The driver of a commercial motor vehicle when traveling upon a downgrade shall not coast with the clutch disengaged.

Note:

A. Coasting on the *level* and *uphill* with the transmission in neutral is lawful.

B. In a non-commercial vehicle, coasting uphill, downhill and on the level with the clutch down is not against Iowa law.

Fact: Coasting in *neutral will not damage automatic transmissions.*

Fac[illegible] Children coast with free-wheeling bicycles.
(In "free-wheeling" vehicles there is no transmission drag or hold-back when the power is cut.)

C. Promptly turn off engine when you reach your destination.

D. Speeding the engine up just before turning it off is thought by some to "prime" the engine with fuel for the next start. This practice is ineffective and wastes fuel.

E. If the engine "diesels," your idling speed could be too high or the octane count of your fuel may be too low. Gasohol with a higher octane could be the solution. Try reducing idling speed first.

3.9 Stick Shift

Objectives:

Operate a stick shift skillfully to gain maximum fuel economy.

A. Follow your owner's manual for correct shifting speeds.

B. Smooth pedal actions lead to greater fuel economy.

C. Sudden gas pedal movements cause the accelerator pump to squirt extra fuel into the carburetor.

D. As you shift upward, gas pedal movements must become progressively smaller to keep from wasting fuel.

E. Diesel vehicles can be shifted sooner and pulled harder without wasting fuel.

F. Skip gears downhill.

G. Do not allow speed to drop greatly before up-shifting when going uphill.

Vehicle Operation

1. Fewest number engine revolutions per trip
2. Fewest number of stops
3. Fewest possible speed changes
4. Short idling periods
5. Accelerate gradually
6. Shift at normal speeds
7. Drive at an even speed
8. Coast as far as possible
9. Stay at or under 55 limit

True/False Learning Exercise — Vehicle Operation

1. To start a cold engine, pump the gas pedal several times.
2. In many cars you can get better gas mileage by driving 20 mph instead of 30 mph.
3. It is best not to feed gas when starting a warm engine.
4. Speeding up the engine just before turning it off makes it start better.
5. You get better gas mileage by accelerating briskly instead of gradually.
6. Driving with the defroster turned on will reduce the gas mileage in most cars.
7. Your reason for driving can strongly influence your gas mileage.
8. The person who concentrates on his/her driving is apt to get better gas mileage.
9. In a full-size car, sudden, hard acceleration can drop gas mileage to three or four miles per gallon.
10. It is never a good idea to run your vehicle past the normal shifting speeds.

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True/False Feedback — Vehicle Operation

1. F For most properly adjusted carburetors only one pump of the gas pedal is needed. Some cars may take two pumps, but try one pump first.

2. F Tests with a variety of cars show that gas mileage drops off below 30 mph. A steady speed at 20 mph will still produce very good miles per gallon.

3. T For most warmed-up engines all you need is a twist of the key. Feeding gas then only makes noise and gets you nowhere.

4. F Save your fuel. There won't be any of that around on your next start.

5. F Tests on a number of different kinds and sizes of vehicles, including one at the DOE Test Facility, show that gradual acceleration uses less fuel. DOE rightly contends that accelerating briskly gets you up to speed with less fuel consumed. The problem is that dividing fuel consumed into distance traveled results in lower mpg.

6. T With an air-conditioned car, the compressor comes on when the defroster is turned on. Switch the defroster off as soon as you can get along without it.

7. T If you drive competitively or in show-off style, you'll have to pay to play. Think it over. How do you want to spend your money?

8. T Concentration on driving efficiently will help you listen to shifting speeds, adjust to hills, and coast as far as possible for stops. That's just for openers.

9. T Sudden, hard acceleration opens the power valve. Then gas literally runs into the engine. Time saved by rapid acceleration is not worth the cost.

10. F If you have a heavy load, are going uphill, face a strong wind, have the air conditioner on, or combinations of the above, you should drive beyond normal shift speeds.

Learning Aid

Iowa Energy Project

Dollar-Saving Ideas for Fuel-Efficient Drivers

Vehicle Operation

3.1 The one factor that has the most influence on gas mileage is. . .

1.____________________________

3.1 List four human factors that strongly influence gas mileage.

2.____________________________
____
____
____

3.1 How can your reason for driving affect gas mileage?

3.____________________________

3.2 What can be done to hold down the amount of fuel used during start-up?

4.____________________________

3.2 What is the correct way to start a cold engine?

5.____________________________

3.2 List two situations where fast idling speed wastes gas.

6.____________________________
____

3.3 How far can you go on the fuel that is burned while waiting through one traffic light?

7.____________________________

3.3 List two actions that can be taken to save fuel while idling.

8.____________________________
____

3.3 What should one do to cut the fast idle down?

9.____________________________

3.4 What happens when you suddenly jerk your car into forward motion?

10.____________________________

3.4 In the 0-30 acceleration test, how many extra seconds are needed to speed up gradually instead of rapidly?

11.____________________________

3.4 How much did gas mileage drop?

12.____________________________

3.4 List four situations where it is best to speed up past normal shifting speeds.

13.____________________________
____
____
____

3.4 What happens if you accelerate too rapidly?

14.____________________________

3.4 What happens if you accelerate too slowly?

15.____________________________

3.5 What is the ideal speed range for top gas mileage in most cars? 16. ____________________

3.5 What happens to time savings-per-mile when you reach higher speeds? 17. ____________________

3.6 How do directional signals save fuel in traffic? 18. ____________________

3.7 List three control actions you could take that would save fuel. 19. ____________________

____

____

3.8 How does looking far ahead help to save fuel? 20. ____________________

3.8 What causes a car to "run on" after you turn it off? 21. ____________________

3.9 What happens when a driver runs past his/her normal shifting speeds when accelerating? 22. ____________________

3.9 Where can you find out the correct shifting speeds for most cars? 23. ____________________

Learning Aid

Iowa Energy Project

	Dollar-Saving Ideas for Fuel-Efficient Drivers	Vehicle Operation
3.1	The factor that has the most influence on gas mileage is. . .	1. The driver
3.1	List four human factors that strongly influence gas mileage.	2. Knowledge Concentration Motivation Skill
3.1	How can your reason for driving affect gas mileage?	3. Affects your emotions
3.2	What can be done to hold down the amount of fuel used during start-up?	4. Do not feed gas
3.2	What is the correct way to start a cold engine?	5. Press gas pedal to floor, release
3.2	List two situations where fast idling speed wastes gas.	6. Decelerating Standing
3.3	How far can you go on the fuel that is burned while waiting through one traffic light?	7. About two blocks
3.3	List two actions that can be taken to save fuel while idling.	8. Jab gas pedal to stop fast idle Switch engine off
3.3	What should one do to cut the fast idle down?	9. Jab the gas pedal
3.4	What happens when you suddenly jerk your car into forward motion?	10. Waste gas
3.4	In the 0-30 acceleration test, how many extra seconds are needed to speed up gradually instead of rapidly?	11. About two seconds
3.4	How much did gas mileage drop?	12. About 25 percent
3.4	List at least four situations where it is best to speed up past normal shifting speeds.	13. With a heavy load Going uphill In mud, snow, sand Strong wind, air conditioner on

3.4	What happens if you accelerate too rapidly?	14.	Waste gas
3.4	What happens if you accelerate too slowly?	15.	Stay in low gears too long
3.5	What is the ideal speed range for top gas mileage in most cars?	16.	30 to 45 mph
3.5	What happens to time savings-per-mile when you reach higher speeds?	17.	It gets smaller
3.6	How do directional signals save fuel in traffic?	18.	They help others to go
3.7	List three control actions you could take that would save fuel.	19.	Steady foot Steady steering wheel Parking brake off
3.8	How does looking way ahead help you save fuel?	20.	Can coast further
3.8	What causes a car to "run on" after you turn it off?	21.	Engine is running too fast
3.9	What happens when a driver runs past his/her normal shifting speeds when speeding up?	22.	Burns more fuel
3.9	Where can you find out the correct shifting speeds for most cars?	23.	Owner's manual

Test - Vehicle Operation

1. On the average, the one factor that influences gas mileage most is . . .

   a. Roadway design.
   b. Engine size.
   c. Driver actions.
   d. Kind of fuel used.

2. To restart a warm engine, you should . . .

   a. Not feed any gas.
   b. Feed gas 1/4.
   c. Pump gas pedal to floor and release.
   d. Pump gas pedal and then feed ¼ pedal.

3. You are stopped for a train. You should turn the engine off if it appears that you will be standing longer than . . .

   a. Ten seconds.
   b. Sixty seconds.
   c. Two minutes.
   d. Five minutes.

4. Which of the following will result in top fuel economy?

   a. Warm up engine five minutes before driving.
   b. Accelerate gradually.
   c. Keep your speed under 25 mph.
   d. Drive as near 55 mph as is safe and legal.

5. When an automatic transmission shifts to second gear at 22 mph instead of the usual 17 mph, it *could* be due to . . .

   a. The driver feeding too much gas.
   b. The car going up a steep hill.
   c. A strong head wind and loaded car.
   d. Any one of these.

6. Which strategy will result in an improvement in gas mileage?

   a. Drive 55 instead of 40 mph.
   b. Drive 20 instead of 30 mph.
   c. Drive a steady speed.
   d. Shift gears for speed changes.

7. Which of these can save fuel as a result of the signals you show in traffic?

   a. Drivers behind you.
   b. Oncoming drivers.
   c. Drivers to your right and left.
   d. All of these.

8. Which driver action cuts gas mileage most?

   a. Nervous movement of gas pedal.
   b. Moving steering wheel slightly.
   c. Left foot poised over brake pedal.
   d. Failure to feed gas while starting engine.

9. If your car "diesels" or "runs-on" after you turn it off, which action is NOT recommended?

   a. Reduce idling speed.
   b. Use a better grade of fuel.
   c. Get a tune-up.
   d. Put car in gear, then turn it off.

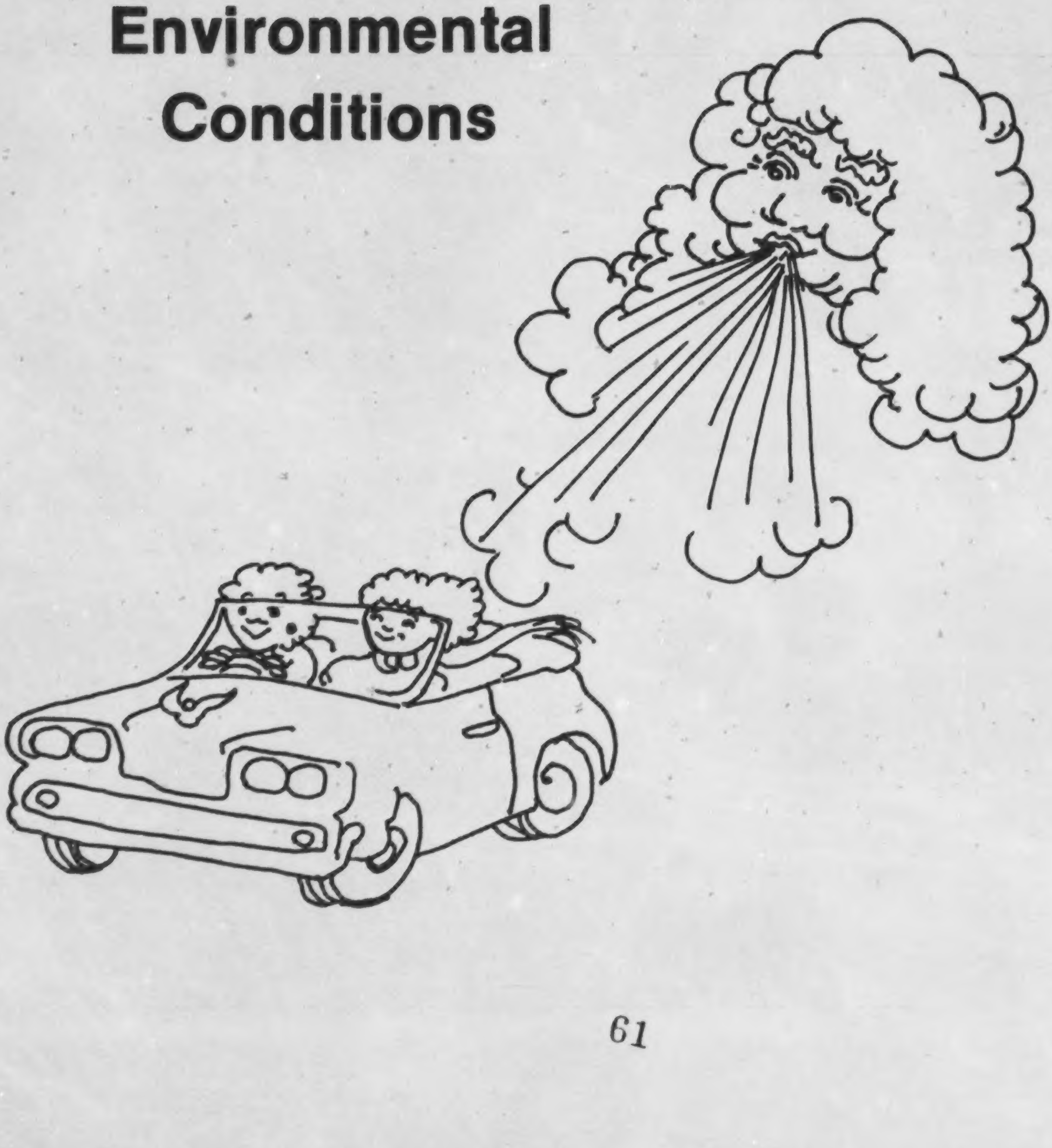
10. Which of the following can cut gas mileage with a stick shift?

a. When you shift.
b. How you operate the clutch.
c. How much gas you feed.
d. All of these.

Cover answers before making copies

1. c (3.1), 2. a (3.2), 3. b (3.3), 4. b (3. 4), 5. d (3.4),
6. c (3.5), 7. d (3.6), 8. a (3.7), 9. c (3.8), 10. d (3.9)

Environmental Conditions



Environmental Conditions

4.0 Environmental Conditions

Most drivers are not aware of the extent of the effect weather and road conditions have on fuel economy.

4.1 Cold Starts

Even 80 degrees is not warm enough to avoid paying for warm-ups.

4.2 Warm-Ups

All drive team parts including the engine, transmission, differential, wheel bearings and tires must be warmed up before you can expect normal economy.

4.3 Vehicle Cool-down

Temperature has a strong effect on how quickly a vehicle warms up and how efficiently it will operate.

4.4 Temperature Change

You must be ready to take the right kind of action to protect vehicle components and to maximize fuel economy when temperatures take a seasonal decline.

4.5 Temperature Extremes

Knowing exactly what to do under extreme heat and cold conditions can affect both your comfort and fuel economy.

4.6 Wind

Don't underestimate the effect wind can have on gas mileage.

4.7 Roadway Surfaces

The route and path you choose as well as vehicle equipment and driving techniques can strongly influence fuel economy and safety.

4.8 Rain, Snow and Ice

Snow can greatly increase rolling resistance at a time when engine efficiency is far below normal.

4.9 Hills

The last thing a fuel-efficient driver wants to do is to be forced to rapidly build speed going uphill.

4.0 Environmental Conditions

4.1 Cold Starts

Objectives:

Minimize the number of cold starts you pay for per day.

A. At any air temperature, summer or winter, a cold vehicle does not produce good gas mileage.

B. Most trips are less than one mile in length. A great deal of motor vehicle fuel is consumed under cold vehicle conditions.

C. In hot or cold weather, a cold vehicle must reach normal operating temperature before maximum fuel economy can be gained.

Example:

A 1978 Chevrolet Caprice, 305 V-8 engine, temperature 80 degrees, on a cold start yielded 7.5 miles per gallon in the first three-quarters of a mile driven. Mileage improved to 10 miles per gallon at the end of one mile. In cold weather cold vehicle mileage will probably drop to three or four mpg the first mile.

D. A cold engine does not allow fuel to vaporize and burn efficiently. The automatic choke and fast idle are required to keep a cold engine running. This reduces fuel economy.

E. Rolling resistance is the second part of the cold vehicle problem. Between 40 and 60 degrees, a vehicle must be driven about 15 miles to warm heavy oil in the rear axle.

Tires resist flexing when cold. Under some conditions tires must be driven up to 30 miles to become completely warmed up.

F. Test results, 1976 Buick coast-down test:

Speed-20 mph. Vehicle shifted to neutral and allowed to roll to a stop.

36 degrees - rolling distance .25 miles. (cold vehicle)
70 degrees - rolling distance .40 miles. (warmed-up vehicle)

G. An engine operating on a cold start, well below optimum, must move a more resistant vehicle. Fuel economy is no better than a fully warmed-up hot rod that is accelerating hard.

H. In extremely cold weather, the car may never fully warm up.

4.2 Warm-Ups

Objectives:

Minimize the amount of fuel your engine takes during the warm-up period.

A. At any air temperature a cooled-down vehicle must be warmed up to gain the best fuel economy.

B. Standing warm-ups waste fuel because they are not needed to prevent engine wear. Ninety-five percent of all engine wear takes place the first 10 seconds an engine runs.

C. A five-minute standing warm-up at 32 degrees will burn enough fuel to move a 1978 Chevrolet two miles.

D. Driving warm-ups are recommended. After about 30 seconds running time, begin moving. Drive at moderate speeds at first.

E. A warmed-up engine does not produce a warmed-up car. All other drive components must also be warmed up.

F. At a 10-degree air temperature a vehicle must be driven about 12 miles to be completely warmed up.

G. Snap the gas pedal downward quickly to slow down fast idle.

4.3 Vehicle Cool-Down

Objectives:

Minimize the amount your vehicle cools down between trips.

A. When an engine is turned off, grease, oil, and moving parts begin to cool down. This includes the engine, transmission, U-joints, rear axle, wheel bearings, and tires.

B. Vehicle cool-down takes place summer and winter alike.

C. How much and how rapidly the vehicle cools down depends on wind, air temperature, and exposure to sun.

D. Actions you can take:

  1. At home:

    a. Combine trips to avoid paying for a warm-up for each trip.

    b. Garage car between trips in cold weather.

  2. Away from home:

    a. Park in a sunny, sheltered area.

    b. Avoid parking headed into the wind.

4.4 Temperature Change

Objectives:

Be sensitive to seasonal temperature declines so you can take proper measures and understand the reason for poor winter gas mileage.

A. The best temperature for maximum fuel economy is about 70 degrees. Below this temperature, fuel economy drops off.

B. At 50 mph, fuel economy drops off two percent for each 10 degree drop in temperature. With other conditions being equal, a car will burn 16 percent more fuel at zero degrees than it would at 30 degrees.

C. Tire pressure goes down one pound for each 10-degree temperature drop.

D. Air becomes more dense as the temperature falls. This increases air drag,requiring more power.

4.5 Temperature Extremes

Objectives:

Minimize cool-down of vehicle. Exploit heat build-up for as many errands as possible.

A. With cool temperatures and a sun-heated car, run your air conditioner long enough to cool the air system. Then switch to "vent" to cool your car and save fuel.

B. In summer, park in the shade to reduce the amount of air conditioner operation.

C. When the defroster is turned on, the air conditioner compressor operates. Turn it off as soon as you no longer need defrosting.

1978 Chevrolet - Cold Start

-16 DEGREES 30 MPH PACKED SNOW

1 mi.	8 mpg
2 mi.	10 mpg
3 mi.	12 mpg

4.6 Wind

Objectives:

Exploit tailwinds. Minimize the effects of headwinds.

A. Direction and Velocity

To determine wind speed and direction, check dust, smoke, flags, windmills, and the direction grass and trees are leaning.

B. Crosswinds

Crosswinds cause only minor decreases in fuel economy.

C. Air Drag and Power

At highway speeds, 60 to 70 percent of the power is needed to overcome wind and air resistance.

D. Frontal Area

The greater the frontal area of a vehicle, the greater the effect of wind and air resistance.

E. Cold Air

Cold air is heavier and offers more resistance.

F. Aerodynamic Drag and Speed

Speed increases of 55 to 65 mph decrease gas mileage 16 percent in 10 sub-compact cars tested.

G. Wind and Miles Per Gallon

A head wind reduces fuel economy more than most drivers suspect.

Here is the effect of an 18 mph wind on a vehicle normally yielding 20 mpg:

18 mph head wind	10% decrease	-2 mpg.
18 mph tail wind	12% gain	+2.4 mpg.
18 mph crosswind	1% loss	-.2 mpg.

H. Air Speed and Ground Speed

Driving 55 mph into a 40 mph head wind produces a 95 mph air speed.

I. Windows Closed at Higher Speeds?

It is recommended that windows be closed at highway speeds to reduce aerodynamic drag. But consider this:

1. With a 55 mph ground speed and a 30 mph tail wind, your air speed is only 25 mph. In this event, cooling the vehicle with the windows down would be more economical.
2. On the other hand, if your ground speed is 30 mph into 25 mph head wind, your air speed would then be 55 mph. Windows closed would then be more fuel efficient.
3. Tests with some cars show very little change in fuel consumed with windows down.

J. How to Compensate

1. If traffic permits, reduce your speed in strong head winds. On a full size car, fuel economy improves about one mpg for each five-mph decrease in speed.
2. The wind usually dies down at sunset. With a larger vehicle such as a motor home, driving at night instead of facing a head wind could improve fuel economy considerably.
3. When accelerating into a strong wind, compensate by reaching higher speeds before shifting to a higher gear.

4.7 Roadway Surfaces

Objectives:

Conserve fuel, maintain control, and prevent vehicle damage.

A. Railroad Crossings

1. Not so fast that you damage vehicle.
2. Not so slow that you waste fuel speeding up.
3. Remember which crossings are smooth.

4. Steer out of normal path for smoother surface.

5. On multi-lane roads use lane with smoothest path.

B. Gravel Roads

1. Choose firmest, smoothest path with least amount of loose gravel.

2. A 1978 Chevrolet gets 27 mpg at 30 mph on pavement and 17 mpg on loose gravel.

C. Potholes

1. Learn to steer to right of pothole when meeting cars.

2. Driving around potholes is preferable to slowing down and going through them.

3. A 1978 Chevrolet gets 27.8 mpg at 30 mph on smooth pavement and 19.5 on rough, patched blacktop.

D. Mud

1. Mud cuts down gas mileage because of greater rolling resistance.

2. A 1978 Chevrolet gets 17 mpg at 30 mph in mud and 27 mpg on dry pavement.

3. Mud under fenders and chassis increases weight and reduces mpg.

E. Snow and Economy

Driving through snow can reduce fuel economy by two or more miles per gallon. If possible, avoid driving until snow has been cleared.

F. Main Streets and Highways

In bad weather, avoid travel on lightly traveled streets and highways. Major road maintenance results in less rolling resistance and better traction.

G. Rolling Resistance

In snow or slush try to drive in the tracks made by other drivers. Getting out of the tracks could greatly increase fuel consumption.

H. Snow Tires

Snow tires take more power. Do not put them on too soon. Do not leave them on after the snow season is over.

1. All-Weather Tires

All-weather radials take less power, grip wet pavement better, and give excellent traction in snow.

2. Tire Chains

There are times when chains are needed. They take lots of power. Take them off as soon as conditions permit.

3. Starting on Ice

   To keep the wheels from spinning, release the brake and allow the car to start rolling forward. Then feed gas lightly and increase the power as the vehicle speeds up.

4. Spinning Wheels

   When a rear wheel spins, apply the parking brake gently. If wheel still spins, apply more parking brake until both wheels pull.

5. Accelerating on Ice

   To accelerate on ice, steer out of the icy path to a place where there is better traction. In residential areas, best traction can be found along the curb. On highways, shoulders usually provide better traction.

6. When You Are Stuck

   Do not spin your tires and race the engine. Use a garden rake to pull snow from under the car. Shovel path for tires. Rock car gently.

7. Stop Signs

   When you approach a stop sign, move to the spot that will provide the best traction for starting.

8. Parking

   Choose a spot that will be easy to get out of. When your wheels spin you get zero miles per gallon. Avoid deep snow, uphill, and streets with high crowns.

4.8 Rain, Snow, and Ice

Objectives:

Minimize the amount of rolling resistance you encounter in water or snow.

Minimize the amount of time you spend in lower gears.

Minimize the number of times your wheels turn per trip.

A. Wet Pavement

   1. Driving in rain cools tires and drive train components and also increases rolling resistance.
   2. Rain tires give better fuel economy and traction than do snow tires.
   3. Drive in the tracks of drivers ahead to cut fuel consumption and increase traction.
   4. Stay away from the curb lane where water is deeper.

B. Ice, Snow and Slush

1. Coast-down test with 1976 Buick Le Sabre.

Air Temp.	Vehicle Temp.	Speed	Surface	Distance Rolled
65 degrees	warm	20	dry	.40 mile
13 degrees	cold	20	dry	.15 mile
9 degrees	cold	20	4" snow	.08 mile
22 degrees	warm	20	8" snow	.04 mile

2. Drive train will not warm up when driven in watery slush.

3. A 1978 Chevrolet (warm vehicle) at 20 mph on a dry road gets 25 mpg; with four inches of wet slush mileage is 12 mpg; and with tracks in slush, 15 mpg.

4. Remove Snow

   Remove snow from vehicle before driving. Snow increases rolling resistance and air drag.

5. Clear Fenders

   Remove snow and slush from underside of fenders to prevent weight buildup and vehicle handling problems.

4.9 Hills

Objectives:

Exploit downgrades for acceleration.

Avoid building speed going uphill.

A. Effects of Hills

Effects of hills on a vehicle normally producing 20 mpg:

1. A three percent grade (three inch rise per 100 inch) can reduce gas mileage by 30 percent.
2. A seven percent grade can reduce fuel economy about 50 percent or about 10 miles per gallon.

B. Going Downhill

1. Accelerate gradually. Allow the downgrade to do most of the work of speeding up.
2. Do not go over the speed limit. The cost of a fine outweighs any savings that might be gained by going faster.

C. Cruise Control on Hills

1. If the cruise control suddenly accelerates your car as you start uphill, tap your brake and take control. Otherwise gas mileage can be cut in half.
2. Cruise control is fairly efficient on gentle grades such as those on interstate highways.

D. Techniques for Hills

1. Build speed going downhill. Allow speed to decrease about five mph going uphill. A sensitive driver can easily beat a cruise control in hilly country.
2. On long upgrades there is no way to win. You must pay the price of going uphill with a steady speed.

E. Altitude in Mountains

Air becomes three percent lighter for each 1000 feet increase in elevation. Octane count of fuel can be lower in mountains. Regular grade gasoline is recommended. Carburetor can be set leaner.

Ideal Environmental Conditions

1. Temperature 70 degrees
2. No head wind . . . tail wind helps
3. Good traction
4. Low rolling resistance . . . smooth, firm surface
5. Level, straight roads

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Ideal Route Conditions

Protected street or highway

Multi-lane . . . wide lanes

One-way, with minimum speed changes

Progressive lights with fewer stops

True/False Learning Exercise — Temperature

1. A five-minute standing warm-up saves fuel.
2. Warmed-up tires give better gas mileage.
3. A cold start has no effect on summertime fuel economy.
4. With cold starts, you will get better gas mileage on a five-mile trip than you would on five one-mile trips.
5. The colder the temperature, the greater the rolling resistance.
6. A warmed-up engine is not a warmed-up vehicle.
7. Ninty-five percent of all engine wear takes place in the first 10 seconds of operation.
8. When the defroster is turned on, the air conditioner compressor is also in operation.
9. Tire pressure drops one pound for each 10-degree temperature drop.
10. Parking out of the wind in winter saves fuel.

True/False Answer Feedback — Temperature

1. F Quite the opposite, it wastes fuel. As soon as the engine stays running smoothly, drive it off.
2. T Air pressure builds up and the tires flex more easily, resulting in better gas mileage.
3. F Summer, winter, anytime, driving on cold starts affects gas mileage.
4. T Those short, cold drives pick your pockets.
5. T Lubricants in the drive train and the tires all get stiffer as they cool down.
6. T A standing warm-up will warm up the engine. But you must drive awhile before the drive train catches up. The result: not the improvement in gas mileage you hoped for.
7. T There goes your excuse for a standing warm-up.
8. T That is why you will want to turn the defroster off after your windshield is cleared.
9. T This is why you want to keep a sharp eye on tire pressures when temperatures begin to slide in the fall.
10. T Wind cools your car down more rapidly, and that can cut into your pizza money.

True/False Learning Exercise — Wind, Snow, Hills

1. It is possible to drive 55 mph and yet have only a 25 mph air speed.
2. With a strong head wind you can save fuel by reducing speed five mph.
3. Each 100 pounds of snow left on your car can reduce your mpg by one percent.
4. Snow tires take less power than regular tires.
5. To start on ice, let the car roll slightly first.
6. To speed up on ice, it is best to stay in the traveled path.
7. While climbing a steep hill, the best economy is gained by speeding up slightly.
8. Higher octane fuel is required for mountain driving.
9. Cold starts affect gas mileage only in cold weather.
10. In snow and slush it is best to drive in the tracks of others.

True/False Answer Feedback — Wind, Snow, Hills

1. T With a 30 mph tail wind, your effective air speed is 25 mph.
2. T When you drive 55 mph into a 40 mph head wind, your air speed is 95 mph. This amount of air resistance will drastically affect gas mileage. Slowing down five mph should save one mpg.
3. T This is why you must remove snow from your car before you drive. Fuel economy is a whole bunch of one percents. Slush under your fenders is another example.
4. F The tread is thick. That takes more fuel.
5. T If fuel were not an issue, this technique would still be a good idea because you can get started more quickly.
6. F Get out of that icy path. You will save fuel and have better control.
7. F Gaining speed uphill is the last thing you want to do.
8. F That is the wrong direction to take. Regular works just fine in the mountains.
9. F Every cold start takes extra fuel. Even at an outdoor temperature of 100 degrees, coolants in the engine and lubricants are far from normal operating temperatures.
10. T Rolling resistance is much greater when you blaze a new trail in snow or slush.

Learning Aid

Iowa Energy Project

	Dollar-Saving Ideas for Fuel-Efficient Driver	Environmental Conditions
4.1	Why are one-mile trips not fuel efficient?	1.____________________
4.1	What two things are part of the rolling resistance problem?	2.____________________ ____________________
4.1	What else besides rolling resistance cuts gas mileage in a cold vehicle?	3.____________________
4.2	What is the best way to warm up a cold car?	4.____________________
4.2	Why is a five-minute warm-up not a good idea?	5.____________________
4.2	What is the longest time one should normally idle a cold engine?	6.____________________
4.3	Three factors that determine the rate of cool-down are . . .	7.____________________ ____________________ ____________________ ____________________
4.3	Two things you can do to reduce cool-down at home are . . .	8.____________________ ____________________
4.3	Two things you can do to reduce cool-down away from home are	9.____________________ ____________________
4.4	How much will fuel economy decrease for each 10-degree temperature drop?	10.____________________
4.4	How much does tire pressure decrease for each 10-degree temperature drop?	11.____________________
4.4	What happens to air resistance as air gets colder?	12.____________________
4.5	Why should the defroster be turned off when it is no longer needed?	13.____________________
4.5	How much did -16 degrees reduce gas mileage the first mile?	14.____________________
4.6	How much was gas mileage decreased when speed was increased from 55 to 65 mph?	15.____________________

4.6 In a 30 mpg car, how many miles per gallon would you lose by increasing the speed from 55 to 65 mph? 16. ______________________

4.6 When you drive 55 mph into a 40 mph head wind, what is your air speed? 17. ______________________

4.6 What can you do to reduce fuel consumption in a head wind? 18. ______________________

4.7 At railroad crossings, you should head for the ________ surface. 19. ______________________

4.7 Which is the most economical; change speed, or change path? 20. ______________________

4.7 How much greater was rolling resistance in snow at nine degrees than it was without snow at 13 degrees? 21. ______________________

4.7 How much did mileage drop when the Chevrolet was driven in loose gravel? 22. ______________________

4.7 What are two rules that apply to snow tires and fuel? 23. ______________________

____

4.8 Why does driving in rain or slush reduce gas mileage? 24. ______________________

____

4.8 How much does a temperature drop from 65 to 13 degrees decrease rolling distance in a coast-down test? 25. ______________________

4.9 How much will an average (three percent) hill cut gas mileage? 26. ______________________

4.9 On which of these should you NOT build speed? On the level - uphill - downhill 27. ______________________

4.9 What happens to fuel quality needs in the mountains? 28. ______________________

4.9 How should you build speed downhill? 29. ______________________

4.9 How can one tell to disconnect cruise control in hilly country? 30. ______________________

Learning Aid

Iowa Energy Project

	Dollar-Saving Ideas for Fuel-Efficient Drivers	Environmental Conditions
4.1	Why are one-mile trips not fuel efficient?	1. Cold vehicle operation
4.1	What two things are part of the rolling resistance problem?	2. Tires Lubricants
4.1	What else besides rolling resistance cuts gas mileage in a cold vehicle?	3. Fast-idle and choke
4.2	What is the best way to warm up a cold car?	4. Start it and drive it
4.2	Why is a five-minute warm-up not a good idea?	5. It wastes fuel
4.2	What is the longest time one should normally idle a cold engine?	6. 30 seconds
4.3	Three factors that determine the rate of cool-down are . . .	7. Time Temperature Wind
4.3	Two things you can do to reduce cool-down at home are . . .	8. Garage car in very cold weather Combine trips
4.3	Two things you can do to reduce cool-down away from home are	9. Park in sunny, sheltered area Don't head car into wind
4.4	How much will fuel economy decrease for each 10-degree temperature drop?	10. Two percent
4.4	How much does tire pressure decrease for each 10-degree temperature drop?	11. One pound
4.4	What happens to air resistance as air gets colder?	12. Increases
4.5	Why should the defroster be turned off when it is no longer needed?	13. Air conditioner compressor runs
4.5	How much did - 16 degrees reduce gas mileage the first mile?	14. About one third
4.6	How much was gas mileage decreased when speed was increased from 55 to 65 mph?	15. 16 percent

4.6	In a 30 mpg car, how many miles per gallon would you lose by increasing the speed from 55 to 65 mph?	16. 4.8 mpg
4.6	When you drive 55 mph into a 40 mph head wind, what is your air speed?	17. 95 mph
4.6	What can you do to reduce fuel consumption in a head wind?	18. Reduce speed
4.7	At railroad crossings, you should head for the ________ surface.	19. Smoothest
4.7	Which is the most economical; change speed or change path?	20. Change path
4.7	How much greater was rolling resistance in snow at nine degrees than it was without snow at 13 degrees?	21. Car rolled .07 mile less
4.7	How much did mileage drop when the Chevrolet was driven in loose gravel?	22. 10 mpg
4.7	What are two rules that apply to snow tires and fuel?	23. Don't put them on too soon Take them off when not needed
4.8	Why does driving in rain or slush reduce gas mileage?	24. It cools drive train, Increases rolling resistance
4.8	How much does a temperature drop from 65 to 13 degrees decrease rolling distance in a coast-down test?	25. .25 mile
4.9	How much will an average (three percent) hill cut gas mileage?	26. 30 percent or six mpg
4.9	On which of these should you NOT build speed? On the level - uphill - downhill	27. Uphill
4.9	What happens to fuel quality needs in the mountains?	28. Lower grades work well
4.9	How should you build speed downhill?	29. Gradually
4.9	How can one tell to disconnect cruise control in hilly country?	30. Car suddenly accelerates

Answers for page 71

1. d (4.3) 2. c (4.1) 3. a (4.2) 4. a (4.2) 5. d (4.4)
6. a (4.5) 7. c (4.6) 8. d (4.3) 9. b (4.8) 10. c (4.9)

Test - Environmental Conditions

Answers are on page 70

1. Which of the following will slow down the rate of cool-down away from home?

   a. Cover the grill or radiator
   b. Park headed with the wind
   c. Park in a sunny sheltered area
   d. All of these

2. Reduced gas mileage due to cold starts is a problem . . .

   a. Primarily when a car is parked outdoors
   b. At below freezing temperatures
   c. At any air temperature
   d. In cars without electric engine heaters

3. Which is the most efficient way to warm a car up?

   a. Begin driving within 30 seconds
   b. Drive slowly in first gear at first
   c. Let engine run about five minutes
   d. Wait until the heater throws heat before driving

4. Which length trip produces the poorest gas mileage?

   a. One mile
   b. Five miles
   c. 10 miles
   d. 15 miles

5. With all other factors equal, at which temperature should one gain the best gas mileage?

   a. 0 degrees
   b. 32 degrees
   c. 50 degrees
   d. 70 degrees

6. Which one cuts gas mileage most?

   a. Defroster
   b. Set heater on "vent"
   c. Heater

7. The major reason for reduced gas mileage above 50 miles per hour is . . .

   a. Rolling resistance of tires
   b. Friction within the vehicle
   c. Air resistance
   d. Reduced engine efficiency

8. How much your vehicle cools down between drives depends on . . .

   a. Wind
   b. Temperature
   c. Time
   d. All of these

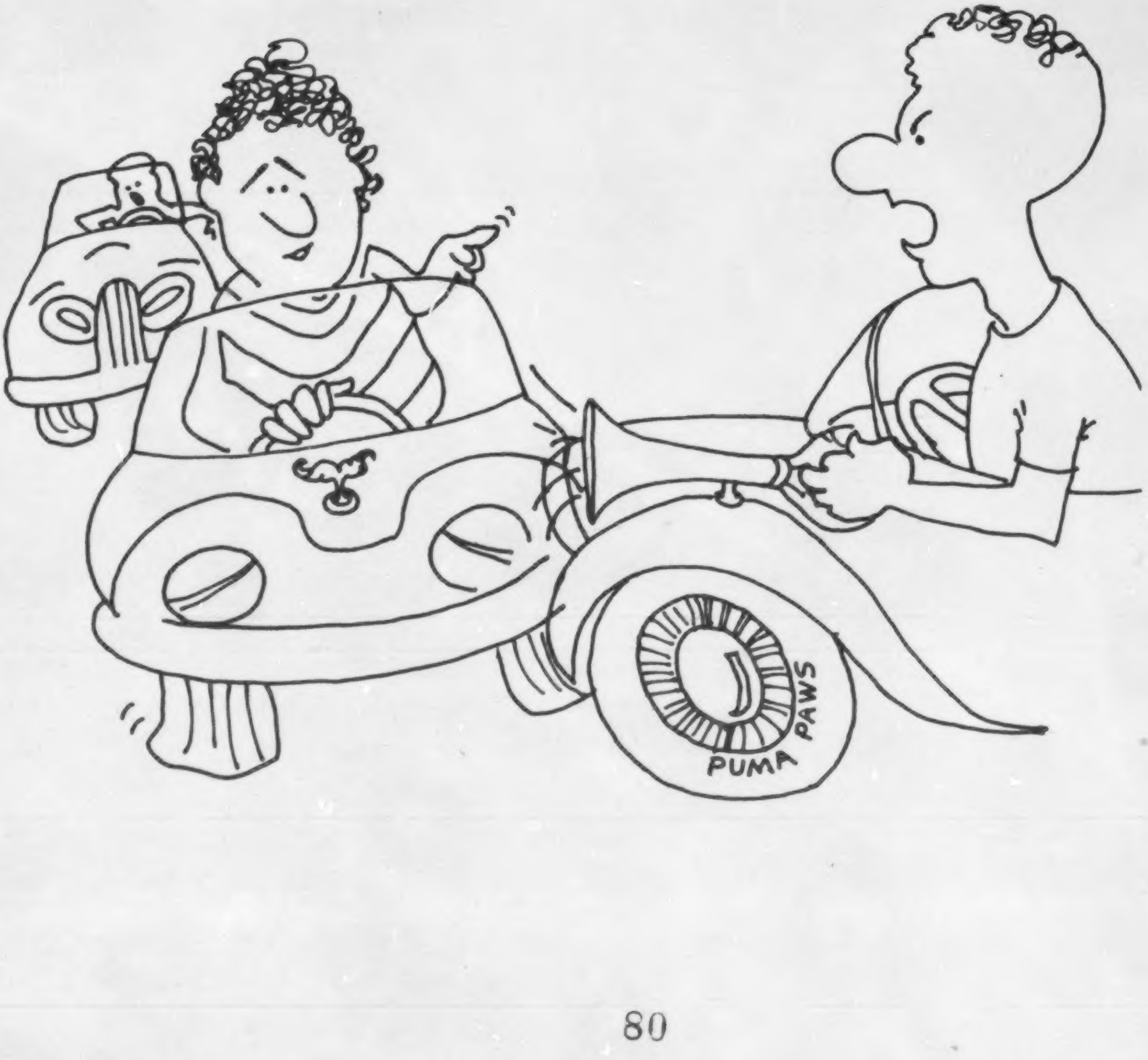
9. The best way to start on ice is to . . .

   a. Feed gas first
   b. Allow car to roll first
   c. Gradually release brake as you feed gas
   d. None of these

10. The most fuel efficient way to drive on hills is to . . .

    a. Build speed uphill
    b. Maintain speed uphill
    c. Lose speed uphill
    d. None of these

Traffic Strategies



Traffic Strategies

5.0 Traffic Strategies

The longer you wait to react to traffic problems, the more fuel you spend handling them. Safe is not always fuel-efficient and fuel-efficient is not always safe. A fine line separates the two. Your job is to know which side of the line to take.

5.1 Look, Think and Act

Concentrate continuously for economy and safety. If you lose your concentration, you are no longer in charge. You can then become a victim.

5.2 Your Speed-Timing-Path Position Combination

Be in charge with your STP combination for maximum fuel economy.

5.3 Traffic Controls

Time your approach and "coasting in" at traffic controls to greatly improve gas mileage.

5.4 Gap Selection for Maneuvers

You can avoid hard acceleration by waiting for easy gaps for all maneuvers.

5.5 Encounters with Other Users

Look for actions of other users that could force you to slow or stop.

5.6 Parking

You can save fuel parking by using a few simple strategies.

5.0 Cost-Cutting Traffic Strategies

Objectives:

Minimize the number and degree of speed changes.

Minimize the number of stops and starts in traffic.

5.1 Seeing and Thinking

Objectives:

See developing problems soon enough to be able to react in a fuel-efficient manner.

A. Concentrate Continuously

1. Continuous concentration and planning are needed to be "in charge" in traffic.
2. Passive "take-it-as-it-comes" drivers tend to become "victims" who are forced into frequent speed changes and stops.

B. Seeing

1. Look as far ahead as possible. Take advantage of hills and curves.
2. Change lanes if something ahead blocks your view.
3. In urban areas, look 30 to 45 seconds ahead.
4. Look for problems that could force you to slow down or to stop.
5. The shorter your visual lead, the greater the speed change needed to handle a problem ahead.
6. The longer you wait to react to a problem, the more fuel you are likely to spend handling it.

C. Long Visual Lead . . . Advantages

1. Steadier speed
2. Coast further
3. Fewer stops
4. Save on brakes
5. Reduced tire wear
6. Make better time

5.2 Your Speed-Path-Position Combination

Objectives:

Establish a Speed-Time-Path-Position combination that will reduce the number of problems you encounter and permit you to move at a steady speed in or near the economy range.

Reduce the number of traffic-related stops.

Reduce the amount of time spent in the lower gears.

Reduce the number of times rapid acceleration is used.

A. Driver Needs for Safety and Economy

Visibility ------------------ To see
Time ---------------------- To think and act
Traction ------------------ For control
Space --------------------- To maneuver
Distance ------------------ To stop

B. Be "In Charge," Not a Victim

1. You must be in charge of your speed, timing, path and position.
2. This combination determines how much can happen to you and what you can do about it.

C. Outcomes of Being an "In Charge" Driver

1. Minimize the number and degree of threats
2. Easier to drive around problems
3. Increased fuel economy
4. Make better time

D. Steady Speed Strategies

1. Try to maintain a steady speed in traffic.
2. Drive the speed which most other drivers are driving.
3. When safe and legal, change path-position to avoid speed changes.

Most city speed limits lie within the "top economy" range of 20 to 40 mph. At these speeds it is possible to gain excellent gas mileage if the number of stops and speed changes are minimized. Changing path is much more economical than changing speed.

Test Conditions

1978 Chevrolet Caprice with 305 engine. Tires 35 PSI.

Straight, smooth, level concrete . . . Temperature 80 degrees, no wind.

Speed and Gas Mileage

SPEED MPH	FUEL IN 1/1000 GAL.	DIST. IN MILES	MPH
10			14
20	.040	1.00	25
25	.063	1.67	26.5
30	.055	1.52	27.63
35	.111	2.85	25.47
40	.113	2.67	23.85
45			22.3
50	.048		20.83
55			20.00

E. Path Selection

Objectives:

Select a path of travel that presents the fewest problems, threats and hazards.

1. Minimize your vulnerabilities.
   - a. Avoid the lane next to parked cars.
   - b. Drive in the curb lane of a four-lane, two-way street if there are no parked cars.
   - c. Drive in the middle lane of a six-lane, two-way road.
   - d. Drive in the left lane of a four-lane, two-way road where left turn lanes are provided.
2. Path Selection Strategies
   - a. Head for the open lane if it is safe and legal to do so.
   - b. Change path when your lane is about to be blocked.
   - c. Move away from pathside problems. A lane change is not always necessary. Consider moving one-half lane width.

F. Positioning Your Vehicle in Traffic

Objectives:

Select a position that provides adequate, stable space, then change as needed.

Maintain a position that will reduce threats from others and also provide maneuvering space around problems.

1. Managing Vehicle Position
   - a. You have the most control of the space ahead of your car.

    b. You have much less control of the size and shape of the space to the rear and side of your car. Other drivers may enter that space.
    c. Continously evaluate the space around your car. Move to a new position when you notice that there is no maneuvering space.
2. Advantages of a Good Position
    a. Allows you to see and be seen.
    b. Allows time to think and act.
    c. Provides for maneuvering space when needed.

5.3 Traffic Controls

Objectives:

Make the fewest possible number of stops.

Sense stopping situations soon enough to coast as far as possible.

Minimize the number and degree of speed changes.

A. Stop Signs
    1. When approaching stop signs, coast as far as practical. Take advantage of downgrades to coast farther (do not impede the normal flow of traffic).
    2. At multi-lane intersections head for the lane with the shortest line of cars.
    3. At four-way stops preview side traffic as you approach so that you will not waste your own and other drivers' time trying to figure out who should go first.

B. Yield Signs
    1. Do not slow down so much that you waste fuel.
    2. Do not approach so fast that you cannot stop in time.

C. Railroad Crossings
    1. Memorize which crossings are smooth and which are not.
    2. Head for the smoothest part of the crossing.
    3. Don't cross so fast that you damage your suspension. Don't cross so slowly that you waste fuel.

D. Traffic Lights
    1. Learn the timing of lights you frequently encounter (count seconds).
    2. Time your approach to red lights so you can reach the intersection after the light turns green.

E. Red Lights

1. Quit feeding gas the instant a light ahead turns red. Coasting with the engine idling produces from 40 to 50 miles per gallon.
2. Check for green as you near the intersection. In this way you can avoid making a stop for a light that is no longer red.

F. Turns on Red

1. Turn right on red after stop where legal. Avoid short gaps that require hard acceleration.
2. Turn left on red from a one-way to another one-way street after stopping. Do not race the engine while waiting.
3. If you fail to turn on red where possible, you not only waste your own fuel but that of others behind you.

G. Progressive Lights

1. Progressive lights permit a steady speed and big fuel savings.
2. If you drive too slowly, you may lag behind the light cycle and be forced to stop.
3. If you drive too fast, you will probably get ahead of the light cycle and be forced to stop.

H. Left Turn Lanes

1. In multi-lane traffic a left-turn arrow ahead is a good indicator that the red light facing you will soon turn green.
2. If there are no cars waiting in the left-turn lane, you can be sure of no delay after intersecting traffic gets a red light.

I. Traffic-Actuated Lights

1. Learn which lights are traffic-actuated.
2. Learn how much time is needed to switch your light after you cross the detector. Pace your approach accordingly.

J. Flashing Red at Railroad Crossings

1. Stop and go if the way is clear.
2. If you must stop and wait, turn off the engine to save fuel.

5.4 Gap Selection for Maneuvers and Fuel Economy

To make any maneuver in traffic, you must have a clear space or gap. Your skill and patience in selecting traffic gaps will strongly influence how much fuel you will burn. Following are a number of ideas that will help you hold fuel costs to a minimum.

Objectives:

For any maneuver, select a gap that permits easy acceleration and minimum fuel consumption.

A. Prerequisite Knowledge

1. Know the time needed for each maneuver.

2. Know the acceleration capabilities of your vehicle.

3. Be able to judge distance. Use city blocks in town and power poles in rural areas.

4. Judge speed in terms of normal, slower than normal, and faster than normal.

B. Trade Time for Fuel

1. You will spend less money if you wait for an easy gap than if you accelerate hard into a short gap.

2. We can no longer afford to burn extra fuel to save time. We must learn to be more patient and spend time to save fuel. Here are some ways that drivers can waste fuel when selecting gaps for traffic maneuvers:

    a. Pass up an adequate gap and remain standing with the engine idling.

    b. Choose a very short gap and accelerate hard.

    c. Choose a long gap and accelerate harder than needed.

    d. Select an adequate gap and fail to speed up, forcing others to slow down.

Acceleration Tests			**DOE Test Facility**	
May 18, 1981			Mercury, Nevada	
0 to 35 mph Acceleration			Dodge Aspen	
Rate	**Time**	**Dist.**	**Fuel**	**mpg**
Gradual	19	.11	.0116	9.482
Brisk	16	.11	.0126	8.7
Hot Rod	15	.11	.014	7.85

Average of three runs at each rate.

C. Maneuvers Initiated from a Standing Position

Just as professional baseball players wait for the "right pitch," you must patiently wait for the "right gap." Size up the whole situation. Look beyond a possible gap to see if a better one is approaching.

1. Entering Traffic From a Parking Space

   When parked, do not start the engine until you see an approaching gap. Learn how many seconds are required to leave any kind of parking space and accelerate to speed.

2. Crossing Traffic From a Stop Sign

   Choose your traffic gap and release the brake pedal as gap nears you. Get in time with the gap. Begin moving as the gap or opening nears the intersection. Waiting until the vehicle passes shortens your gap and forces hard acceleration.

3. Joining Traffic From a Stop Sign or Red Light

You must do more than get around the corner before the approaching vehicle gets to the intersection. As you accelerate, your average speed is half that of the approaching vehicle. It is far cheaper to wait for an easy gap than to accelerate hard into a short one.

D. Maneuvers Initiated While Moving

Selecting gaps or openings in traffic requires skill and knowledge. Careful positioning is a valuable aid in making it possible to move into gaps with minimum acceleration.

1. Left Turns With Oncoming Traffic

Turning left into oncoming traffic, time your approach so you can turn without stopping your car. Stopping takes extra fuel. Avoid short gaps that require hard acceleration.

2. Changing Lanes

Look far ahead for factors that could cause you to slow or stop. The earlier you react, the easier it will be to change lanes with a minimal speed change.

3. Passing on a Two-Way Road

Avoid using the passing gear if at all possible. Be patient. Wait for a gap that requires moderate acceleration. Keep in mind that while you are driving less than the speed limit, your speed could be in the economy range.

4. Merging With Another Lane of Traffic

The more you drop your speed, the more fuel you must burn gaining cruising speed. Get in time with a gap and try to match its speed. Avoid flooring the gas pedal just because you are entering a freeway.

5. Turning Around

The U-turn, where legal, is the most efficient way of turning around because the vehicle need not always be stopped. All other methods of turning around require a full stop and could use more fuel.

5.5 Encounters with Other Users

Objectives:

Look for things that could slow you down or force you to stop.

Handle all conflicts by acting early, minimizing fuel consumption without compromising safety.

A. Closure with ongoing vehicles, either slow-moving or stopped. Look far ahead.

1. Action Priorities---Minimize speed changes and number of stops.

Action Priorities in Traffic

Most Economical	Maintain speed and steer around problems.

Less Economical	Slow down and wait for problem.
Least Economical	Stop. Stay back from problem. Accelerate gradually.

B. Merging From Next Lane

1. Avoid blind-spotting, side-by-side driving, or driving in bunches.
2. Move away from pathside threats.

C. At Intersections

1. Don't drive so slowly that you waste fuel.
2. Don't drive so fast that you can't stop.

5.6 Parking

Objectives:

Look for parking places that will be easy to leave.

Minimize the amount of fuel consumed when parking.

A. Don't cruise around looking for a parking space next to the doorway.

B. Avoid parking near a traffic light where a line of parked cars could keep you from leaving easily.

C. Sharpen your parking skills so you can quickly park with minimum fuel consumption.

D. At shopping centers leave before closing time to avoid long lines at the exit.

E. In winter consider the ease of leaving a parking space before you park there.

Handling Problems

Dollar-Saving Strategies:

Most Economical,
Drive around problem while maintaining speed.

Less Economical,
Slow down, drive around problem and accelerate gradually.

Least Economical,
Stop, stay back from problem. Accelerate gradually.

Gap Selection

1. Look beyond a possible gap for an easier gap

2. It is cheaper to wait than to charge

3. Your waiting must not interfere with others:

   Stop signs
   Turns on red
   Left turns
   Passing
   Merging
   Changing lanes

Never Make a Safety Trade-Off to Save Fuel

1. At intersections
2. Near pedestrians
3. Reduced field of view
4. Reduced width
5. Near pathside hazards
6. Reduced traction

1

True/False Learning Exercise — Traffic Strategies

1. How well you are able to move in traffic is largely a matter of luck.
2. For best fuel economy it is better to change path than to change speed.
3. Space around your car in traffic can have an important influence on your gas mileage.
4. Best fuel economy can be gained at 55 mph.
5. The further you think ahead, the further you may possibly coast.
6. A steady speed is one of our best fuel savers.
7. Any slow speed is better than a stop.
8. You can wait a full minute at a stop sign and not burn as much fuel as you would speeding up rapidly.
9. Driving at the speed most others drive usually saves fuel.
10. Highly skilled and experienced drivers get the best gas mileage when they drive automatically or subconsciously.

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True/False Answer Feedback — Traffic Strategies

1. F It is a result of skill, concentration and planning. Without these, it is not possible to get top gas mileage.
2. T When safe, legal and practical, it is best to drive around problems. Slow-downs pick your pocket.
3. T Open space around your car allows you to drive around problems when they develop.
4. F The most economical speed for most cars is about 30 mph. Highway mileage happens to be better for many drivers because there is less stop-start driving.
5. T The shorter your view ahead, the shorter the time between seeing a problem and having to stop for it. That means less coasting.
6. T Tests under traffic conditions show that changing speed and stop-start driving can cut gas mileage to half or less.
7. T Even at 10 mph, gas mileage will be about 14 mpg in a GM full-size car. Stop-start driving can drop your mileage in that same car to 5 or 6 mpg.
8. T You can stand and wait using a fraction of the fuel that would be needed to speed up rapidly.
9. T Any speed you give up must be regained with fuel you have paid for.
10. F Remember the thing about looking far ahead for problems and having space to steer around them? That takes concentration.

Learning Aid

Iowa Energy Project

Dollar-Saving Ideas for Fuel-Efficient Drivers

Traffic Strategies

5.1 What is needed to be "in charge" in traffic?	1. ______________________ ______________________
5.1 List two things you can do to see developing problems as early as possible.	2. ______________________ ______________________
5.1 List two outcomes of employing driving strategies.	3. ______________________ ______________________
5.2 List the four driver needs for safety and economy.	4. ______________________ ______________________ ______________________ ______________________
5.2 What four STP factors must you be in charge of?	5. ______________________ ______________________ ______________________ ______________________
5.2 What are three outcomes of being an "in-charge" driver?	6. ______________________ ______________________ ______________________
5.2 List two steady speed strategies.	7. ______________________ ______________________
5.2 At what speed does the 1978 Chevrolet get the best gas mileage?	8. ______________________
5.2 What happens to gas mileage when speed is above the ideal level?	9. ______________________

5.2 What were the conditions under which these mileages were gained?

10. ____________________

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5.2 How much difference is there in gas mileage in the city driving speed range of 20 to 40 mph?

11. ____________________

5.2 At which speed range is there the greatest potential for top gas mileage, town or country?

12. ____________________

5.2 List three advantages of good vehicle position in traffic.

13. ____________________

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5.3 List three objectives when approaching traffic controls.

14. ____________________

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5.3 How can one save fuel at stop signs?

15. ____________________

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5.3 What happens when you slow down too much at a yield sign?

16. ____________________

5.3 What could happen if you go too fast at a yield sign?

17. ____________________

5.3 List two fuel-saving strategies for protected crossings.

18. ____________________

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5.3 What strategy should one use approaching a red traffic light?

19. ____________________

5.3 List two things you can do to minimize your vulnerabilities along your path of travel.

20. ____________________

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5.3 What is the advantage of having open space beside your car?

21. ____________________

5.3 Over which area of space around your car do drivers have the most control?

22. ____________________

5.3 What should you do when you notice that you have inadequate swerve space beside your car?

23. ____________________

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5.3 Where may you turn left on red? 24. ____________________

5.3 What is the advantage of progressive lights? 25. ____________________

5.3 What happens if you drive too slowly or too fast with progressive lights? 26. ____________________

5.3 If you are stopped by a train, what can you do to save fuel? 27. ____________________

5.4 When joining a gap in traffic, which maneuvers are the most wasteful? 28. ____________________

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5.4 How can you get in time with a gap at a stop sign? 29. ____________________

5.4 Which is more economical at a stop sign, wait or charge? 30. ____________________

5.4 When approaching to make a left turn with an oncoming car, what should your fuel-saving strategy be? 31. ____________________

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5.4 The longer you wait to change lanes, the more __________ it will cost you. 32. ____________________

5.4 What can you do to minimize fuel consumption while passing? 33. ____________________

5.4 When merging, the more you slow down, the . . . 34. ____________________

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5.4 Which is the most efficient way to turn around? 35. ____________________

5.5 List four actions that one can take to save fuel when parking. 36. ____________________

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5.5 In their correct order, list the three action priorities needed to cope with traffic problems. 37. ____________________

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5.6 How can you reduce the possiblity of pathside threats? 38. ____________________

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Learning Aid

Iowa Energy Project

Dollar-Saving Ideas for Fuel-Efficient Drivers	Traffic Strategies
5.1 What is needed to be "in charge" in traffic?	1. Plan Continous concentration
5.1 List two things you can do to see developing problems as early as possible.	2. Position vehicle Look far ahead
5.1 List two outcomes of employing driving strategies.	3. Steadier speed Coast further
5.2 List the four driver needs for safety and economy.	4. Visibility to see Time to think and act Traction for control Space to maneuver
5.2 What four STP factors must you be in charge of?	5. Speed Timing Path Position
5.2 What are three outcomes of being an "in-charge" driver?	6. Reduced number of threats Easy to drive around problems Better fuel economy
5.2 List two steady speed strategies.	7. Same speed as others Change path and position
5.2 At what speeds does the 1978 Chevrolet get the best gas mileage?	8. 30 mph
5.2 What happens to gas mileage when speed is above the ideal level?	9. It goes down

5.2	What were the conditions under which these mileages were gained?	10. Straight road Smooth road Level road 80 degrees No wind
5.2	How much difference is there in gas mileage in the city driving speed range of 20 to 40 mph?	11. About one mpg
5.2	At which speed range is there the greatest potential for top gas mileage, town or country?	12. In town
5.2	List three advantages of good vehicle position in traffic.	13. See and be seen Time to think and act Space to maneuver
5.3	List three objectives when approaching traffic controls.	14. Fewest possible stops Fewest possible speed changes Coast as far and often as possible
5.3	How can one save fuel at stop signs?	15. Begin coasting early Take lane with shortest line
5.3	What happens when you slow down too much at a yield sign?	16. Waste fuel speeding up
5.3	What could happen if you go too fast at a yield sign?	17. Can't stop in time
5.3	List two fuel-saving strategies for protected railroad crossings.	18. Cross at smoothest part Don't slow down too much
5.3	What strategy should one use approaching a red traffic light?	19. Time your approach
5.3	List two things you can do to minimize your vulnerabilities along your path of travel.	20. Avoid lane beside parked cars Take center lane on three-lane street

5.3	What is the advantage of having open space beside your car?	21.	One can drive around problems
5.3	Over which area of space around your car do drivers have the most control?	22.	Ahead and to the sides
5.3	What should you do when you notice that you have inadequate swerve space beside your car?	23.	Increase following distance Find a new position
5.3	Where may you turn left on red?	24.	From a one-way to a one-way street
5.3	What is the advantage of progressive lights?	25.	Steady speed, good gas mileage
5.3	What happens if you drive too slowly or too fast with progressive lights?	26.	You will be forced to stop
5.3	If you are stopped by a train, what can you do to save fuel?	27.	Turn off engine
5.4	When joining a gap in traffic, which maneuvers are the most wasteful?	28.	Accelerating hard in short gap Accelerating hard when not needed
5.4	How can you get in time with a gap at a stop sign?	29.	Begin moving as gap nears
5.4	Which is more economical at a stop sign, wait or charge?	30.	Wait
5.4	When approaching to make a left turn with an oncoming car, what should your fuel saving strategy be?	31.	Time approach so you don't have to stop
5.4	The longer you wait to change lanes, the more __________ it will cost you.	32.	Fuel
5.4	What can you do to minimize fuel consumption while passing?	33.	Wait for a long passing zone
5.4	When merging, the more you slow down, the . . .	34.	More fuel you burn returning to cruising speed
5.4	Which is the most efficient way to turn around?	35.	U-turn
5.5	List four actions that one can take to save fuel when parking.	36.	Don't look for a close parking space Don't park near traffic light Sharpen parking skills Leave before closing time

5.5 In their correct order, list the three action priorities needed to cope with traffic problems.

37. Keep speed and drive around

Slow down and time approach

Stop back from problem

5.6 How can you reduce the possiblity of pathside threats?

38. Avoid blind-spotting others

Stay out of bunches

Answers for page 94

1) b (5.4) 2) c (5.4) 3) b (5.1) 4) d (5.2) 5) d (5.3) 6) a (5.2)
7) c (5.5) 8) c (5.1) 9) d (5.2) 10) c (5.2)

Test - Traffic Strategies

Answers are on page 93

1. Which will cost you the most money in city traffic?

   a. Drive at 20 to 30 mph
   b. Speed up from a stopped position
   c. Wait 30 seconds at a traffic light
   d. Slow to 20 mph and speed up to 30

2. Which is the least expensive way to select and enter a traffic gap?

   a. Select a short gap and accelerate rapidly
   b. Select a medium gap and accelerate briskly
   c. Select a longer gap and accelerate gradually

3. At which speed is it possible to drive with the lowest fuel cost in most cars?

   a. 15 to 20 mph b. 25 to 35 mph c. 45 to 55 mph

4. Where should a driver expect to make the fewest speed changes?

   a. In the right lane next to parked cars
   b. In the left lane of a four-lane, two-way street
   c. In the furthermost left lane of a one-way street
   d. In the center lane of a one-way street

5. At controlled railroad crossings, which is best for lowest fuel costs?

   a. Slow down for all crossings
   b. Not so fast that you damage your car
   c. Not so slow that you waste fuel
   d. Both b and c

6. Which action will result in the greatest fuel cost?

   a. Changing speed
   b. Changing lanes
   c Changing position relative to others
   d. Steering away from a threat

7. The least expensive way to handle a traffic problem is to . . .

   a. Slow down for it
   b. Stop for it
   c. Keep speed and drive around it
   d. Slow down and drive around it

8. How far should you look ahead in city traffic?

   a. One block
   b. About two blocks
   c. As far as you can see

9. When you are following a car, which is most important to driving around problems in traffic?

   a. Space ahead of you
   b. Space behind you
   c. Space beside you
   d. Both a and c

10. Which is the best strategy to use for top gas mileage in traffic?

    a. Relax and take it as it comes
    b. Pick up an STP stance and stick with it
    c. Change your STP stance as needed
    d. React to events instead of conditions

Planning for Savings

SUPER MKT
CLEANERS
GAS
BANK
SCHOOL

Planning for Savings

6.0 Planning for Savings

By planning ahead, you can make significant fuel savings even before you get behind the wheel.

6.1 Short Trips with Cold Vehicles Waste Gas

On short trips you car never has a chance to warm up. That's hard on the engine and the pocketbook.

6.2 Keep an Errand List

Keep an errand list and you'll cut down on the number of single-purpose trips.

6.3 Is this Trip Necessary?

You save most when your car is on the driveway or in the garage. Drive only when necessary.

6.4 Time and Timing

The time you choose to drive will allow you to sail along at a fuel-saving steady speed or cause you to plod along in gas guzzling stop-and-go traffic.

6.5 How to Choose the Best Route

Driving an economy car is not enough. Choose the route with the fewest negative factors. You'll save time and money.

6.6 Trip Records for Analysis

Keeping trip records is as valuable to fuel-sensitive drivers as are game films to coaches.

6.0 Planning for Savings

You cannot do anything about the price, but you can control the amount of gas you use.

Objectives:

Reduce the number of short trips with cold vehicles.

Reduce the total number of miles driven.

6.1 Short Trips with Cold Vehicles Waste Gas

Test drive ...... 1976 Buick LeSabre Temp. 52 degrees Cold vehicle 10/2/80

DISTANCE IN MILES	TOTAL FUEL USED	MILES PER GAL. (AVERAGE)	COST PER MILE @ $1.20
.5	.096 gal.	5.2	23 cents
1.0	.131 gal.	7.6	15.78 cents
1.5	.160 gal.	9.37	12.8 cents
2.0	.183 gal.	10.9	11.0 cents
3.0	.242 gal.	12.14	9.88 cents
5.0	.332 gal.	15.00	8.00 cents
6.0	.380 gal.	15.78	7.60 cents

Traffic conditions caused the fourth mile reading to be missed.

A 25-gallon tank would provide the following:

5.2 mpg	130 miles
7.6 mpg	190 miles
15.78 mpg	394 miles

The vehicle was not totally warmed up in the fifth mile, but the fuel cost was half that of the first mile and a third that of the first half-mile traveled.

6.2 Keep an Errand List

A. One trip for each thing you need isn't economical.

B. What do you need, or need to do?

C. Is there any way to do it without making a cold-vehicle, single-purpose trip?

D. Exploit the schedule of another family member.

   1. Do your errand before another person must drive.
   2. Wait until another family member returns with a warm car.

6.3 Is this Trip Necessary?

A. Is this trip an impulsive, spur-of-the-moment trip? Impulsive trips are often single-purpose trips.

B. Is this a no-purpose, cruise-around trip? Greatest savings are made when you don't drive.

C. If it's for a bargain, will you save more than the trip costs?

6.4 Time and Timing

A. Try to choose a time when all your errands can be done in one trip.

B. If you drive to work, leave early to avoid heavy traffic.

C. If trip time is optional, avoid peak traffic times.

D. Allow enough time. Listen to traffic and weather reports. Being late results in hard acceleration and very little coasting.

6.5 How to Choose the Best Route

A. Sequence your stops to cause the least back-driving.

B. Avoid the route with most negative factors:

1. Hills
2. Yield signs
3. Railroad crossings
4. Uncontrolled intersections
5. Unsynchronized traffic lights
6. Intersections
7. Stop signs
8. Turns or corners
9. Pathside hazards
10. Traffic bottlenecks

C. Choose a route with the most positive factors:

1. Smooth surface
2. Wide lanes
3. One-way streets
4. Multi-lane streets
5. Light traffic
6. Protected left turns
7. Left-turn lanes
8. Speed limit near 30 mph

D. The route you choose can drastically affect fuel economy. Here is an actual experience:

1976 Buick LeSabre (Instrumented Waterloo Schools Driver Education Car) - student driver with four passengers, rain with 50 degree temperature, 10/16/80.

Unprotected Street ---------------Speed--uneven and slow

One stop sign, one yield sign, three uncontrolled intersections.

Distance	Fuel	Mpg
.35 miles (5 blocks)	.033 gal.	10.6

Protected Street ----------------- Speed--Steady, 30 mph

Protected Street

Distance	Fuel	Mpg
.35 mile	.016 gal.	21.8

6.6 Trip Records for Analysis

A. Determine vehicle use.

B. Decide where you can reduce the number of trips and total mileage.

People Miles

Mpg Rating	Miles Traveled	Gallons Burned	Passengers Per Car	People Miles	People Miles Per Gallon
20	100	5	6	600	120
30	100	3.33	4	400	120
40	100	2.5	2	200	80
40	100	2.5	1	100	40

Forty million people drive to work alone. Notice that six people in a 20-mpg car is three times more fuel-efficient than one person in a 40-mpg car.

How to Analyze Your Trip Record

- **Destination** - Have you made a number of single-purpose trips that could have been combined?
- **Date** - Have you taken repeat trips to the same destination that could have been avoided?
- **Time** - Did you drive at "peak traffic" times when the trip could have been taken in an off-peak time?
- **Load** - How much of the time did you take single-passenger trips? A moped or "person mover" car could be the answer.
- **Vehicle Temperature** - How much of your driving was in "cold temperature" operation?
- **Air Temperature** - Did you take your trips in the coldest part of the day in winter and the hottest part of the day in summer?
- **Miles** - Check out how you might save miles next week by planning, combining or eliminating some trips. Multiply this mileage by 52 to determine how many miles you would go in a year.
- **Purpose** - How important was each trip? Try to weed out trips that have no real purpose or good reason.

Waste-Watcher's Trip Analysis Guide

Why keep records?

- To determine the number and kind of trips taken per week.
- To determine the exact distance to each destination.
- To reduce fuel consumption without reducing quality of life.
- To reduce the number of single-purpose trips.
- To reduce the amount of gas-guzzling, cold-temperature trips.
- To exploit the warmed-up vehicle.
- To determine the actual cost of driving to each destination.

Waste-Watcher's Trip Record

Part 1

Destination	Date	Time	Load

The Better You Plan, the More You Save

Air Temperature	Vehicle Temperature	Miles	Purpose

Planning Strategies

1. Maintain trip records

2. Avoid single-purpose trips

3. Drive warmed-up vehicle instead of cold one

4. Drive most economical vehicle

5. Avoid peak traffic times

6. Allow adequate time . . . don't buy time with fuel

7. Ride-share for maximum "people miles"

8. Avoid cool-down of vehicle

True/False Learning Exercise — Planning for Economy

1. A "want list" can help you save fuel.
2. The cost of driving a cold vehicle one mile can be three times the cost of driving a warmed-up vehicle the same distance.
3. If you wait for the return of a warmed-up vehicle to take your trip, you can save fuel.
4. Best fuel economy results when each person drives his/her own car.
5. One trip for each thing is not conservation.
6. A driver who is late usually burns more fuel.
7. The best route to take in traffic often depends on the time of day.
8. Driving on unprotected side streets can cut your mpg in half.
9. Gas mileage of cold vehicles driven on short trips is reduced only in winter.
10. Cruising with a warmed-up vehicle saves fuel.

True/False Feedback — Planning for Economy

1. T Keeping a list will help you do more errands on one warm-up.
2. T An engine running at a low level of efficiency must struggle to move a resistant vehicle. That takes lots of extra fuel.
3. T Depending on how far the other person has driven, you can easily cut your fuel consumption to a fraction of what it would be with a cold car.
4. F That way you pay for two warm-ups. When practical, try to make it with one vehicle.
5. T One trip for each thing shows poor planning and makes each of those things cost more.
6. T Most drivers, when late, accelerate harder and coast less.
7. T A given route may be heavily traveled following a shift change and be quiet at other times.
8. T There is nothing like a steady speed to stretch a gallon of gas.
9. F Even in summer, at 80 degrees, a cold start takes extra fuel. At that temperature cars warm up quickly and cool down more slowly.
10. F Aimless cruising is always a waste of fuel. Dollars we send to OPEC can't be used to equip factories that create jobs.

Learning Aid

Iowa Energy Project

Dollar-Saving Ideas for Fuel-Efficient Drivers

Planning For Savings

6.0 List two ways that you can cut fuel use through planning.

1. ______________________________

____

6.1 What happens to cost-per-mile as a car warms up?

2. ______________________________

6.1 What part of total fuel was burned in the first mile?

3. ______________________________

6.2 What is the purpose of an errand or "want" list?

4. ______________________________

6.3 Which kind of trip results in the greatest waste of fuel?

5. ______________________________

6.4 List four time techniques you can use to save fuel.

6. ______________________________

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6.5 List four fuel-wasting factors that you encounter as you ride or drive.

7. ______________________________

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6.5 List the five route factors that help to improve gas mileage most.

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8. ______________________________

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6.5 How much did fuel economy drop when the Buick was driven on an unprotected street?

9. ______________________________

6.6 (See *Waste Watcher's Trip Analysis Guide*). List what you feel to be the four most important reasons for keeping records.

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10. ______________________________

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6.6 (See *How to Analyze Your Trip*). List the three factors that have the greatest potential to save fuel.

11. ______________________________

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Learning Aid

Iowa Energy Project

Dollar-Saving Ideas for Fuel-Efficient Drivers		Planning For Savings
6.0	List two ways that you can cut fuel use through planning.	1. Don't drive Reduce number of cold starts
6.1	What happens to cost per mile as a car warms up?	2. *Goes down*
6.1	What part of total fuel was burned in the first mile?	3. One third
6.2	What is the purpose of an errand or "want" list?	4. Combine trips
6.3	Which kind of trip results in the greatest waste of fuel?	5. Impulsive
6.4	List four time techniques you can use to save fuel.	6. Leave early Avoid peak times Allow enough time Combine trips
6.5	List four fuel-wasting factors that you encounter as you ride or drive.	7. Hills Intersections Bottlenecks Traffic lights
6.5	List the five route factors that help to improve gas mileage most. Near 30 mph Light traffic	8. Smooth routes Multi-lane One-way
6.5	How much did fuel economy drop when the Buick was driven on an unprotected street?	9. Half
6.6	(See *Waste Watcher's Trip Analysis Guide*). List what you feel to be the four most important reasons for keeping records. Determine number and kind of trips	10. Reduce fuel consumption Reduce cold temp. trips Know route to destination
6.6	(See *How to Analyze Your Trip*). List the three factors that have the greatest potential to save fuel.	11. Multi-purpose trips Warmed-up vehicle Avoid peak times

Exploiting Alternatives

Exploiting Alternatives

7.0 Exploiting Alternatives

Any time you use a more efficient way of moving people and goods, you are helping to assure the future of our country.

7.1 Ride Sharing and Car Pooling

Ride sharing can cut your costs to a fraction of normal.

7.2 Van Pooling

There are more advantages to van pooling than saving fuel and money.

7.3 Public Transportation

Public transportation is one of the most fuel-efficient ways of moving people from place to place.

7.4 Two-Wheeled Vehicles

Two-wheeled vehicles are great fuel savers. There are some advantages, but there are also disadvantages.

7.5 Telephone

Save time and money by phoning instead of driving.

7.6 Mail

Consider conducting business by mail. It doesn't always take a trip in your car to make a business transaction.

7.7 Catalog Sales

Shopping by catalog can save fuel.

7.0 Exploiting Alternatives

Objectives:

When practical, use the most fuel-efficient mode of transportation.

When possible, conduct business transactions without using any fuel.

7.1 Ride Sharing and Car Pooling

Fact: Commuting to school and work is the largest single vehicle use.

Fact: Seventy percent of all people drive to work alone.

Objective:

Increase the number of passenger miles from each gallon of fuel consumed.

Car Pooling and "Passenger Miles"

Most everyone is familiar with "miles per gallon" but very few have heard of the "passenger miles" concept. Take a look at the table below and you will see that fuel efficiency depends partly upon the number of people being transported.

Passenger Miles

Mpg	Miles	Gallons	Passengers	Passenger Miles	Passenger Miles Per Gallon
20	100	5	6	600	120
30	100	3.33	4	400	120
40	100	2.5	2	200	80
40	100	2.5	1	100	40

Passenger Miles = number of miles traveled x number of passengers (6x100=600).
Passenger Miles Per Gallon = number of passenger miles ÷ gallons of fuel used (600 ÷ 5=120).

Passenger miles gained by a 20-mpg vehicle moving six people is equal to that of a 30-mpg vehicle with four passengers (120 passenger miles per gallon each).

A 40-mpg vehicle moving two passengers produces only 80 passenger miles per gallon.

The same vehicle with only the driver produces only 40 passenger miles per gallon.

A 20-mpg vehicle with two people is just as efficient as a 40 mpg vehicle moving only the driver (100 miles ÷2.5 gallons = 40 passenger miles per gallon).

A. Advantages:

1. You conserve energy.
2. You spend less time driving.
3. Reduced congestion, pollution, and number of accidents.
4. Reduced insurance and maintenance costs.

B. Factors to Consider:

1. If you drive, be on time.
2. Agree on how long you will wait for one who is late.
3. Be sure insurance covers riders.
4. If you are the driver-owner, charge enough to cover all costs.

7.2 Van Pooling

A. A van is an economy vehicle when it is transporting a number of passengers.

B. A van pool may be owned by a company or by a group of individuals.

C. There is usually only one driver.

D. The particular advantage is that the family may need one less vehicle.

7.3 Public Transportation

Objectives:

Exploit a more fuel-efficient form of transportation.

A. Buses

Bus fares may be less than the cost of all-day parking.

B. Reduced Dependence

Large city buses get only three to four miles per gallon, but passenger miles make buses a highly efficient form of transportation. This helps reduce our dependence on foreign oil.

C. Air Travel

A single passenger can often travel for far less by air than by auto. A fully loaded DC-9 Super-80 transports passengers at 75 passenger miles per gallon.

D. Rail Travel

Rail travel is highly fuel-efficient.

When you travel by rail, you save both fuel and money.

E. School Transportation

You waste fuel when:

1. You drive to school when school transportation is available.
2. You drive to an out-of-town event when school transportation is available.

7.4 Two-Wheeled Vehicles

Fact: Two-wheeled vehicles are practical about six months per year.

Fact: Two-wheeled vehicles are ideally suited for short trips when four-wheeled vehicles are at their worst.

A. Cargo Space

To be a practical alternative, a two-wheeled vehicle should provide a means for carrying packages.

B. Bicycle

1. No fuel cost
2. Positive health factor
3. Good person mover

C. Moped

1. Low cost and high fuel economy
2. Can be parked and stored in small space
3. Not safe in heavy or faster traffic
4. Practical range about five miles (can travel about 25 miles in an hour)
5. It carries one passenger and small packages

D. Motorcycle

1. More practical for longer distances and higher speeds
2. Costs more and takes more storage space
3. It carries two passengers and small packages

7.5 Telephone

A. A great deal of driving can be avoided by comparison shopping by phone and by telephone conferences.

B. Call to confirm appointments and the availability of merchandise before your drive.

7.6 Mail

Don't drive several miles to conduct business that could be done by mail.

A. Bank Deposits

B. Bill Payments

7.7 Catalog Sales

Catalog sales can save fuel if you do not drive a considerable distance to pick up your order. Have your order delivered by a commercial service or US Mail.

Exploiting Alternatives

1. Two-wheeled vehicles . . . short trips
2. Bus. . . . . city, school, intercity
3. Car or van pool . . . passenger miles
4. Rent special-purpose vehicles
5. Fly or bus . . . then rent

True/False Learning Exercises — Exploiting Alternatives

1. Seventy percent of all workers drive to work alone.
2. Passenger miles per gallon is a more realistic measure of fuel-efficiency than are miles per gallon.
3. Two people in a 20-mpg vehicle is as efficient as one person in a 40-mpg vehicle.
4. A van can be an economy vehicle.
5. The most efficient way to pay bills is to go there in person.
6. In most cases, driving to school is cheaper than riding the school bus.
7. Two-wheeled vehicles are a good choice for short trips.
8. There are more advantages to van or car pooling than just saving gas and money.
9. Exploiting alternatives refers to driving a different kind of vehicle.
10. You can shop by mail order catalog and still waste fuel.

True/False Feedback — Exploiting Alternatives

1. T We could save a lot of fuel if more people shared rides to work and school.
2. T Miles per gallon measure car-driver efficiency. Passenger miles measure how well the vehicle and fuel are exploited.
3. T The more people you move with a gallon of fuel, the more useful work you get out of it.
4. T When a van is carrying a full load of people, it becomes an economy vehicle. When it carries one person, it is a loser.
5. T Weighing the cost of phone calls and postage stamps against your time and the cost of driving makes going in person a doubtful approach.
6. F School buses move people at a far lower cost than that of going by private car. It's a complete waste when transportation is furnished.
7. T Two-wheeled vehicles take little if any fuel. Short trips with cold vehicles burn large amounts of fuel.
8. T Reduced congestion, reduced pollution and less wear on the family car are some of the advantages of a van pool.
9. F It refers mainly to using public transportation and using other means than driving your car to conduct business.
10. T If you make a trip with your car to pick up the order, your transaction required a trip.

Learning Aid

Iowa Energy Project

Dollar-Saving Ideas for Fuel-Efficient Drivers

Exploiting Alternatives

7.0	List two main objectives of this unit.	1. ______ ______
7.1	What percentage of all drivers drive to work alone?	2. ______
7.1	To get miles per gallon divide ______ by ______.	3. ______ ______
7.1	To get passenger miles multiply ______ x ______.	4. ______ ______
7.1	To get passenger miles per gallon divide ______ by ______.	5. ______ ______
7.1	List three advantages of car pooling or ride sharing.	6. ______ ______ ______
7.2	When is a van an economy vehicle?	7. ______
7.3	What is the objective of this segment?	8. ______
7.3	What makes a bus more fuel-efficient at six miles per gallon?	9. ______
7.3	Give two ways students can waste fuel getting to school and to school events.	10. ______ ______
7.4	Give one advantage two-wheeled vehicles have over four-wheeled vehicles.	11. ______
7.4	List two advantages of a bicycle.	12. ______ ______
7.4	List two advantages motorcycles have over mopeds.	13. ______ ______
7.5	Give a situation where you might use the phone instead of driving.	14. ______
7.5	Give a situation where you could conduct business by mail.	15. ______

Learning Aid

Iowa Energy Project

	Dollar-Saving Ideas for Fuel-Efficient Drivers	Exploiting Alternatives
7.0	List two main objectives of this unit.	1. Use most efficient mode of transportation Avoid using fuel
7.1	What percentage of all drivers drive to work alone?	2. About 70 percent
7.1	To get miles per gallon, divide ________ by ________.	3. Miles Gallons
7.1	To get passenger miles multiply ________ x ________.	4. Miles traveled People moved
7.1	To get passenger miles per gallon divide ________ by ________.	5. Passenger miles Gallons of fuel used
7.1	List three advantages of car pooling or ride sharing.	6. Reduce pollution Reduce accidents Reduce maintenance cost
7.2	When is a van an economy vehicle?	7. When fully loaded
7.3	What is the objective of this segment?	8. Greater fuel efficiency
7.3	What makes a bus more fuel-efficient at six miles per gallon?	9. More passenger miles
7.3	Give two ways students can waste fuel getting to school and to school events.	10. Drive alone Not take the bus
7.4	Give one advantage two-wheeled vehicles have over four-wheeled vehicles.	11. Better for short trips
7.4	List two advantages of a bicycle.	12. They use no fuel Good exercise
7.4	List two advantages motorcycles have over mopeds.	13. Greater range Two-passenger capacity
7.5	Give a situation where you might use the phone instead of driving.	14. Check on prices, etc
7.5	Give a situation where you could conduct business by mail.	15. Pay a bill

Appendix

Fuel-Efficient Instruction Techniques

1. Management

A. **Keep Records:** Documentation of driving records allows the students to know how they are progressing in the program.

B. **Don't Just Go For a Ride:** Anybody can take students for a ride. A well organized professional will want to exploit time and fuel for a maximum instructional effect.

C. **State Objectives:** State your objectives while your driver is doing the pre-start procedure. Use a textbook or other illustrations to show students exactly what you want them to do.

D. **Exploit Observation Time:** Most students would never make it if they had to depend only on what they learn while they are behind the wheel. Shorten the amount of time you spend on a given objective by involving your observers as another person drives.

E. **Correlate Phases of Instruction:** You will spend much less time behind the wheel if you can apply what is learned in class and simulation.

F. ***ENPACS* In the Car:** Carry a set of *ENPACS* in the car so that you can state objectives and students can review.

G. **Miles Per Gallon:** Miles per gallon may not be the true measure of fuel-efficient instruction. It just could be that the high-mpg teacher is going for a ride instead of driving for objectives. Lay out an intensive route that packs a lot of activity into a short distance. Your mileage will be poor, but in the end you will use less fuel and learn more.

H. **Empty Miles:** Have students perform cornering and uncontrolled intersection drills on the way to the practice area. Conduct "yellow light" drills by snapping your fingers at various distances from intersections. Have students respond with a "yes" or "no" until their judgment has improved enough to actually use the brake.

I. **Analyze Performance:** Determine exactly why the student is not performing correctly. If the reason is ignorance, then the place for correction is in the classroom or simulator.

J. **Use a Model Driver:** Select your best driver to demonstrate a new skill. This will allow your remaining drivers to have a better idea of how the task is to be done. If your best driver cannot perform correctly, it could be a good time to demonstrate for them.

K. **When No Progress Is Made:** If it seems that a student is regressing or making no progress, replace him/her with another driver and return that driver to the wheel after he/she has time to observe and hear your explanation.

2. Driving Technique

A. **Steering Wheel Handling:** A great deal of time can be spent learning to turn corners when a driver has poor steering wheel handling skills. "If you cannot handle the wheel, you cannot handle the car." The simulator is the best place to learn steering wheel skills in the shortest time at the lowest cost. Take a drive in your driver education car. Analyze exactly how much steering is needed to turn right and left.

B. **Check Your Drivers for These Factors When They Corner:**

- **Style**—Will the driver's style keep him/her from succeeding?
- **Timing**—Is the driver starting the turn too soon or too late? Reach over and help the student start the turn at the right time.
- **Amount**—Is the driver turning too much or too little?
- **Quickness**—Is the driver turning too slowly or too quickly?
- **Rate**—Does the driver change the rate of steering as needed?

C. **Cornering:** Do not corner so slowly that you must spend extra fuel regaining speed. Do not take a corner so fast that you risk losing control or damaging tires. Extra visual lead is needed to corner safely at slightly higher speeds.

D. **Speeding Up:** Use a vacuum gauge to show student fuel consumption level. Nine inches of mercury will cause the power valve to open. Fuel will then run into the engine. Teach students normal shift speeds for your vehicle. Overruns could indicate that the driver is accelerating too rapidly. Teach students to accelerate with a very light pedal pressure and then gradually ease down on the pedal as the vehicle speeds up. A sudden downward thrust of the gas pedal will cause the accelerator pump to operate. Do not feed more fuel than your engine can efficiently utilize. Avoid driving too far in lower gear. An excessive number of engine revolutions will burn more fuel.

3. Transmission Technique

A. **Automatic:** Establish normal shift speeds for your vehicle. Have students snap their fingers when the shift takes place. If the drivers are overrunning these shift speeds under normal conditions, they are feeding too much gas and dropping the vacuum level too much. (Note: A Marshalltown Gauge will make it very easy to determine when vacuum level is being dropped too much.) There are times when it is best to overrun normal shift speeds depending on loading factors such as wind, surface, and terrain.

B. **Stick Shift:** Avoid shifting down to slow the vehicle. Avoid sudden, large thrusts of the gas pedal. This puts the accelerator pump and power valve into action and increases fuel consumption.

C. **Speed, Timing, and Position Stance:** Require your drivers to be in charge of their speed, timing, and position stance. When safe and legal, your driver should maintain speed in preference to slowing or stopping. Any slow speed is better than stopping. Time your approach to problems so that you can avoid stopping. Choose a path that allows you to see in order to reduce the chance of pathside and in-path problems. Maintain a position that provides space ahead and to the sides. If the space beside is closed, your only response is to slow or stop. Accelerate gradually, not slowly. Tests consistently show that gradual acceleration produces the best gas mileage. DOE is right when it claims that less fuel is burned accelerating briskly up to speed. What it overlooks is that fuel consumed over the distance is greater, and that means poor gas mileage over all.

4. Classroom Techniques

A. **True/False Tests:** Often the first few minutes of most class periods are wasted because there is no formal activity for the students. A true/false test is a good way to solve this problem. Unlike many other kinds of classroom activity, this one involves everyone in the class all of the time. Students participate in this activity more vigorously and more emotionally than in other activities of a more passive nature. The true/false test is a quick way to cover a large number of concepts and propositions. This format is an excellent medium for refuting misconceptions. Be ready to quote authorities. Most true/false questions concern major concepts and are an excellent reinforcement technique. When combined with worksheets, films, discussion, slides, simulation, and on-the-road instruction, there is greater opportunity for learning to persist beyond the short-term level. Students must remember long enough to apply and utilize the concepts in simulation and in the car.

B. **Multiple Choice Tests:** Tests are provided for the first five units. Each test is limited to ten questions to minimize the time spent on that activity. Teachers may wish to use the tests as criterion tests resulting in a grade, or they may wish to use the tests as a learning experience with no grade. If your class is typical, you will probably have a slow reader or two. You can handle the problem in two ways: you may read the questions to the class, or you may have a student assistant read the questions to the slow reader(s) in an adjacent room. In schools where reading teachers are available, they can administer the tests. Experience has shown that it is profitable to tabulate the errors made by the entire class. This tabulation should be stored with the test forms so that those weaknesses can be foreseen when teaching the unit the following semester.

C. **Information Packs:** The seven information packs are written in outline form to facilitate reading and working with the learning aide. These packs were written with a number of audiences in mind. These include high school, college, adult, professional drivers, and others. The high school teacher should feel free to exploit the flexibility of the program. If certain units or segments of units are not desired, they can be easily omitted when making assignments.

D. **Learning Aide:** The learning aide is more than a worksheet. When all blanks have been filled, students may cover the answers with a card and begin answering the questions. The card is moved downward to determine if the answer given is correct. When the students can correctly answer all questions, they are then ready to take the criterion test. You may wish to allow students to use their learning aide on one test in order to penalize those who failed to bring their completed aides to class. The learning aide has another value. It provides a homework activity when there is a lack of class time to spend on the content area. At a time when the school establishment is trying to prove that there are academic activities, the learning aide can serve as an exhibit to parents. Urge your students to share their learning experiences with their parents. You never know when you might need the parents' support.

E. **Simulation:** Simulation is an ideal method to reinforce energy concepts introduced in the classroom. The chance events and conditions in the real world of traffic will not provide frequent enough examples to apply concepts of fuel-efficient driving. Refer to "Fuel-Efficient Instruction Techniques" on page 117 to review concepts and objectives needed for simulation.

We have previously stated that safe is not always efficient and efficient is not always safe. There is a fine line between these two entities, and simulation films contain an abundance of events that teach the idea that one never makes a safety trade-off to save fuel. A number of these principals are contained in the "KODALITH Slide Masters." You may wish to project these at the beginning of films that show examples.

Here are a few examples of concepts that can be taught in simulation:

- **Coasting**—When approaching stop signs, determine when power should be cut and cue the class verbally.
- **Timing**—When approaching a red traffic light, emphasize holding back in order to reach the light after the green comes on. There are many other timing situations.
- **Path**—Many times the path selected in simulation films is not conducive to driving at a steady speed. Ask the group what the problem is and how to improve their traffic stance.
- **Position**—Often the camera car is maintaining a poor vehicle position. Ask the group if they would rather be "in charge" or a "victim."

Only when you know all of the content in all of the units will you be able to exploit simulation as a reinforcing instrument in fuel-efficient driving. The short time you have available for in-car instruction is not sufficient to impress upon students the concepts that will serve them for a lifetime.

F. **Overhead Transparencies:** The transparency masters provided with each of the units can be used in several ways. They are intended to convey ideal models or conditions for maximum fuel economy. Before you project a transparency, ask your students to construct the "ideal vehicle," "ideal environmental conditions," or other models. Then project the transparency and see how close the students came to constructing the model. (We are concerned with participation.) You may wish to project the whole series to serve as a brief overview of the content of the guide. You undoubtedly will want to create your own transparencies to emphasize major concepts. You may wish to use no transparencies at all, or you may wish to use only transparencies with another component due to a lack of time or interest.

5. Use of Instruments

A. **Rationale:** To be a successful in-car instructor of fuel-efficient drivers, you must provide students with definable, measurable goals. You must make students aware that performance matters and that it is being monitored. You must observe, measure, and quantify performance and provide feedback to the students. To quantify performance you will need a stop watch and a vacuum gauge.

B. **Vacuum Gauge:** The Marshalltown Gauge, with the following specifications, is recommended: 14430, 2" fig., 22KC 30" & KPA 1/8" back connection. This gauge is recommended because it is very inexpensive, about $8.00, and rugged and durable. This is the gauge used by the DOE DECAT facility. The Marshalltown Gauge Company will not sell a gauge to an individual. Contact your local auto supply store.

To install the gauge, cut any vacuum line and install with a "T" fitting. Calibrate in the school auto mechanics shop. Mount the gauge on top of the dash. Use flexible rubber hose. Determine the vacuum level at which the transmission will not up-shift as well as the level at which the power valve in the carburetor opens. (See your mechanic if necessary.)

To operate, determine the normal shift speeds for your vehicle. If the student causes the transmission to run past normal shift speeds, too much gas is being fed. Determine a normal gauge deflection for gradual acceleration.

C. **Stop Watch:** Use the stop watch to make a "table of acceleration rates" for 0-25, 0-30, 0-35, 0-40, 0-45, and 0-55 mph. Do not stretch out starts so that the car stays in low gear or second gear for protracted times and distances. With a complete table you can start the watch when the car begins moving and stop it when the car reaches cruising speed. Allow for conditions such as head wind, surface, load, and hills.

Listening Guide — *Running On Empty*

Running On Empty is easily the best fuel conservation film. It is positive, moves fast, involves the listener, and provides important information. If time limits you to one film, this is it.

Included are a listening guide and a true/false test which may be administered either before or after the film. Avoid stopping to fill out each blank in the listening guide. Wait for a natural break, then ask the group to provide the correct answers. Experience has shown that students retain more when they write down content and take tests. These notes will make it easier to review for mid-term and final tests. Most importantly, this exercise and set of notes will make it more likely that the concepts given will be remembered and utilized by the student drivers.

Listening Guide — *Running On Empty*

1. When you cruise at a steady ____ mph you can get good gas mileage.
2. A four-mile trip with a cold vehicle costs about $________.
3. It is best to warm your car up not more than ____ seconds before driving.
4. How should one accelerate from a standing position in traffic? ____________
5. Two disadvantages of "jack rabbit" starts are:

   (1) ______________________________ (2) ______________________________
6. How much time did the "hurry-up" driver save? ______________________
7. How far can one drive at 40 mph on the amount of gas burned in ten minutes of idling? __________
8. What two things are needed for good gas mileage?

   (1) ______________________________ (2) ______________________________
9. Two driver actions that waste gas are:

   (1) ______________________________ (2) ______________________________
10. Why is it possible to get better gas mileage when driving on highways?

    ____
11. How much fuel can be saved by driving 55 mph instead of 75 mph?

    __________ percent
12. What is the best technique to use when driving in hilly country?

    ____
13. What is a good technique for going downhill?

    ____

14. How much fuel can these hilly country techniques save? ______________ percent

15. Which is best at highway speeds?

________________ Windows up ________________ Windows down

16. List three different factors that increase wind resistance.

(1) ______________________ (2) ______________________ (3) ______________________

17. Which maintenance factor most frequently causes poor gas mileage? __________________________

____

18. If tires are ten pounds under-inflated, how much is gas mileage reduced? ______________ percent

19. Can gas mileage be improved by adding air above the recommended inflation level?

_______ Yes _______ No

20. Which is usually needed to improve mpg's? _____ Tune-up _____ Adjustments

21. List six factors that could indicate the need of a tune-up.

(1) ______________________ (2) ______________________ (3) ______________________

(4) ______________________ (5) ______________________ (6) ______________________

22. Which is usually the best grade of gas to use? ______________

23. What mistake did Mrs. Hollander make while doing her five errands?

____

24. How many miles could she have saved by consolidating trips? ______________

25. A car pool can save $_______ to $_______ per year.

26. List four important factors you should consider when buying a car.

(1) _____________________________________ (2) _____________________________________

(3) _____________________________________ (4) _____________________________________

27. How much can be saved on fuel each year by buying the most efficient vehicle in its class?

$_____________________

28. What percent of the contestants beat the EPA rating for their cars?

______________ percent

29. Summarize the fuel-saving tips given by the contestants.

(1) ______________________ (2) ______________________ (3) ______________________

(4) ______________________ (5) ______________________ (6) ______________________

(7) ______________________ (8) ______________________ (9) ______________________

Listening Guide — *Running On Empty*

1. When you cruise at a steady 35 mph you can get good gas mileage.

2. A four-mile trip with a cold vehicle costs about $1.00.

3. It is best to warm your car up not more than 30 seconds before driving.

4. How should one accelerate from a standing position in traffic? Gradually

5. Two disadvantages of "jack rabbit" starts are:

   (1) Wastes gas (2) Hard on tires

6. How much time did the "hurry-up" driver save? None

7. How far can one drive at 40 mph on the amount of gas burned in ten minutes of idling? 5 miles

8. What two things are needed for good gas mileage?

   (1) Steady speed (2) Buffer zone

9. Two driver actions that waste gas are:

   (1) Braking (2) Accelerating

10. Why is it possible to get better gas mileage when driving on highways?

    Steady speed

11. How much fuel can be saved by driving 55 mph instead of 75 mph?

    Over 20 percent

12. What is the best technique to use when driving in hilly country?

    Accelerate before going uphill

13. What is a good technique for going downhill?

    Let gravity help you

14. How much fuel can these "hilly country" techniques save? 5 percent

15. Which is best at highway speeds?

    X Windows up ____ Windows down

16. List three different factors that increase wind resistance.

    (1) Roof rack (2) Large frontal area (3) Open windows

17. Which maintenance factor most frequently causes poor gas mileage? Under-inflated tires

18. If tires are ten pounds under-inflated, how much is gas mileage reduced? Five percent (1 mpg on 20 mpg car)

19. Can gas mileage be improved by adding air above the recommended inflation level?

X Yes ____ No

20. Which is usually needed to improve mpg's? ____ Tune-up X Adjustments

21. List six factors that could indicate the need of a tune-up.

(1) Sputtering
(2) Stalling
(3) Misfiring
(4) Hard starting
(5) Rough idling
(6) Drop in gas mileage

22. Which is usually the best grade of gas to use? Regular

23. What mistake did Mrs. Hollander make while doing her five errands?

Single-purpose trips

24. How many miles could she have saved by consolidating trips? About 15

25. A car pool can save $ 300 to $ 1,000 per year.

26. List four important factors you should consider when buying a car.

(1) Family size
(2) Typical load or cargo
(3) Length of trips
(4) Fuel economy

27. How much can be saved on fuel each year by buying the most efficient vehicle in its class?

$ 400

28. What percent of the contestants beat the EPA rating for their cars?

90 percent

29. Summarize the fuel-saving tips given by the contestants.

(1) Look far ahead
(2) Anticipate
(3) Even speeds
(4) 55 mph or less
(5) Share rides
(6) No single-purpose trips
(7) Timing at traffic lights
(8) Tires near maximum inflation
(9) Tune-up when needed

Do You Know What it Takes to Be a Fuel-Efficient Driver?

True/False Test ***Running on Empty***

Place your answer on an answer sheet provided.

1. Short drives with cold vehicles waste fuel.
2. In cold weather, warm up your vehicle about five minutes before driving.
3. It is best to accelerate quickly to speed up.
4. Following closely can lead to wasted fuel.
5. Braking hard for red lights and stop signs wastes fuel.
6. Accelerate before you start up a hill.
7. You get your best gas mileage at 55 mph.
8. A steady speed improves gas mileage.
9. At highway speeds, driving with the windows down saves fuel.
10. Single - purpose trips save gas.
11. A small car with a small engine is best for most families.
12. It is best to have a tune-up any time your gas mileage goes down.
13. Tires should be inflated according to the owner's manual.
14. The more you use your brakes, the more gas you save.
15. Ninety percent of the drivers in the contest beat the EPA rating for their car.

Answers to True/False Test

Cover answers before making copies

1. T
2. F
3. F
4. T
5. T
6. T
7. F
8. T
9. F
10. F
11. F
12. F
13. F
14. F
15. T

Kodalith . . . . . What it is and how to do it

This packet contains a set of masters that cover rules, principles, concepts and test data.

These can be converted into slides by doing the following:

1. Load a 35 mm camera with **Kodalith** film. Must use **macro** or **copy lens**.
2. Place camera on copy stand and shoot each frame.
3. The developed film will show the black letters white and the background black.
4. These can be mounted in 35 mm mounts and projected with a 35 mm projector.
5. This can be done with full room light. Additional lighting may be necessary. Check directions in film box.
6. You may wish to stain these with felt tip markers or other color stains.
7. Your high school audio-visual department might be able to do this.
8. Most area agencies should be able to do this for you in their production department.

Economy Lanes

- **Stay away from parked cars.**
- **Stay out of left turn lane on two-way streets.**
- **Choose lane that moves best.**

Intersecting

- Not so fast that you risk a crash.
- Not so slow that you waste fuel.

Planning Strategies

- Maintain trip records.
- No single-purpose trips.
- Take a warmed-up car.
- Drive most economical car.

Planning Strategies

- Avoid peak times.
- Don't buy time with fuel.
- Ride-share for people miles.
- Minimize vehicle cool-down.

Ideal Route Conditions

- Straight, smooth, level
- Protected multi-lane
- Wide, lightly traveled
- One way
- Progressive lights

Exploiting Alternatives

- Two-wheeled vehicles
- Bus, city, school, intercity
- Car or van pool = people miles
- Rent special-purpose vehicles
- Fly or bus, then rent
- Telephone, catalog sales

Effects of Snow and Temperature

Coast Tests 1976 Buick LeSabre

V. TEMP	AIR TEMP	SURFACE	SPEED	DIST.
Warm	65	Dry	20	.40
Cold	13	Dry	20	.15
Cold	9	4" Snow	20	.8

Effect of Wind on Fuel Economy

20 MPH WIND	SPEED	DIST.	FUEL	MPG
Head wind	40	3 mi.	.155	19.35
Tail wind	40	3 mi.	.124	24.19
Head wind	50	3 mi.	.165	18.8
Tail wind	50	3 mi.	.141	21.7

Ideal Environmental Conditions

- Temperature 70 degrees
- No head wind, tail wind helps
- Good traction, dry
- Smooth, level surface

Adverse Environmental Factors

- Wind
- Snow and rain
- Hills
- Elevation
- Cold temperatures

Cost of Fuel is Not Cost of Ownership

- Interest
- Depreciation
- Insurance
- Registration
- Sales Tax

Ideal Vehicle

- Light weight
- Small frontal area
- Small engine
- Aerodynamic design
- Most fuel-efficient class
- Passed crash tests
- Few power accessories
- Efficient transmission
- Front-wheel drive
- Transportation needs

Gap Selection

- Crossing and joining at intersections
- Parked and entering traffic
- Changing lanes
- Merging
- Passing

Gap Selection

- Look beyond a possible gap for an easier gap.
- It is cheaper to wait than it is to charge.
- Your waiting must not interfere with others.

Steady Speed

1. Avoid lane next to parked cars.
2. Avoid peak travel times when possible.
3. Take a multi-lane instead of a two-lane street.
4. Take a one-way instead of a two-way street.

Action Priorities in Traffic

Most economical	Maintain speed and go around problems.
Less economical	Slow down and wait for problem.
Least economical	Stop. Stay back from problem, accelerate gradually.

Select a Favorable Position in Traffic

- **Be in charge, don't be a victim.**
- **Arrange for open space.**
- **See and be seen.**
- **Steer around problems.**

Less can happen and you can do more about it.

Timing Influences

- **Fuel consumption $ $ $**
- **Vehicle wear $ $ $**
- **Safety**

Timing is important in all maneuvers.

WatchYour STP Stance

- **Speed - Match speed to conditions.**
- **Timing - Time approach to problems.**
- **Path - Away from parked cars.**
- **Position - Stay out of bunches.**

Traffic Strategies

- Look far ahead.
- Concentrate.
- Select easy gaps.
- Time approach to lights.

Look Far Ahead

- The longer you wait to respond to a traffic problem, the more fuel you will spend handling it.
- Change lane for a closure problem.

Any Action You Take to Save Fuel:

- Must be safe
- Must be legal
- Must be practical
- Must be cost-effective
- Must not damage vehicle
- Must not interfere

Never Make a Safety Trade-Off to Save Fuel:

- At intersections
- Near pedestrians
- Reduced field of view
- Reduced width
- Near pathside hazards
- Reduced traction

Personal Factors

- Your motivations
- Your capabilities and limitations
- Your knowledge

Fuel-Efficient Driving Objectives

1. High engine efficiency
2. Minimum weight
3. Low air drag
4. Efficient driving techniques
5. Effective planning

Transmission Drag and Coasting Distance

1976 Buick Le Sabre **Nov. 6, 1980**

SPEED	TRANSMISSION	DISTANCE
55-40	Drive	.17
55-40	Neutral	.33
40-25	Drive	.18
40-25	Neutral	.34

Tire Pressure and Rolling Resistance

1976 Buick Le Sabre **Steel-Belted Radials**

TIRE PRESSURE		ROLLING DISTANCE
33 PSI	20 mph	.24 mile
30 PSI	20 mph	.24 mile
27 PSI	20 mph	.22 mile
22 PSI	20 mph	.21 mile

Vehicle Operation

- Accelerate gradually.
- Drive an even speed.
- Coast as much as possible.
- Minimize revolutions per trip.

Vehicle Maintenance

• Keep records	• Check tires weekly
• Follow owner's manual	• Align & balance wheels
• Low idling speed	• Use care when fueling

A Warmed Up Engine Is Not a Warmed Up Car

- Transmission
- Wheel bearings
- Differential
- Tires
- Universal joints

When cold, these increase rolling resistance.

Acceleration Tests **DOE Test Facility**

May 18, 1981 **Mercury, Nevada**

0 to 35 mph Acceleration **Dodge Aspen**

RATE	TIME	DIST.	FUEL	MPG
Gradual	19	.11	.0116	9.482
Brisk	16	.11	.0126	8.7
Hot Rod	15	.11	.014	7.85

Average of 3 runs at each rate

Speed and Time Saved

We cannot afford to spend fuel to save time

MPH	10 MILES	20 MILES	50 MILES	100 MILES
55	11 min.	22 min.	55 min.	1:49 min.
60	10 min.	20 min.	50 min.	1:45 min.
65	9 min.	18 min.	46 min.	1:32 min.

Steady Speed Tests **1978 Honda**

August 4, 1980 **70 Degrees, Rain**

SPEED	MPG	SPEED	MPG
10	15	35	28.5
20	33.3	40	41.6
25	40.0	45	45.45
30	33.0	50	38.45
		55	38.45

Steady Speed Tests **1978 Chevrolet**
305

Sept. 8, 1980 **80 Degrees**

SPEED	MPG	SPEED	MPG
10	14	40	23.85
20	25	45	22.3
25	25.6	50	20.83
30	27.63	55	20.00
35	25.47		

0 to 35 mph Acceleration Frenchman's Flats

TIME	DISTANCE	FUEL	MPG
8	.08	.012	7.27
10	.08	.010	8.00
12	.08	.010	8.00
18	.13	.010	13.00
18	0.18	.010	18.00

NOTE: Fuel consumed nearly identical all rates.

0 to 30 Mph Acceleration Test

1978 Chevrolet Dec. 12, 1980

TYPE	DIST.	TIME	FUEL	MPG
Gradual	.10	17 sec.	.011	9.09
Brisk	.10	16 sec.	.012	8.33
Hard	.10	15 sec.	.014	7.14

0 to 35 Mph Acceleration Test

1978 Chevrolet 350 V-8 80 Degrees

RATE	DIST.	TIME	FUEL	MPG
Gradual	.11	16	.014	7.8
Brisk	.09	12	.017	5.2
Hard	.05	6.5	.017	2.9

Speed and Fuel Economy

1. 30 mph generally best speed
2. Too slow wastes fuel
3. Not so fast that you:
   - Waste fuel
   - Risk a crash
   - Violate speed laws

Safe Speed

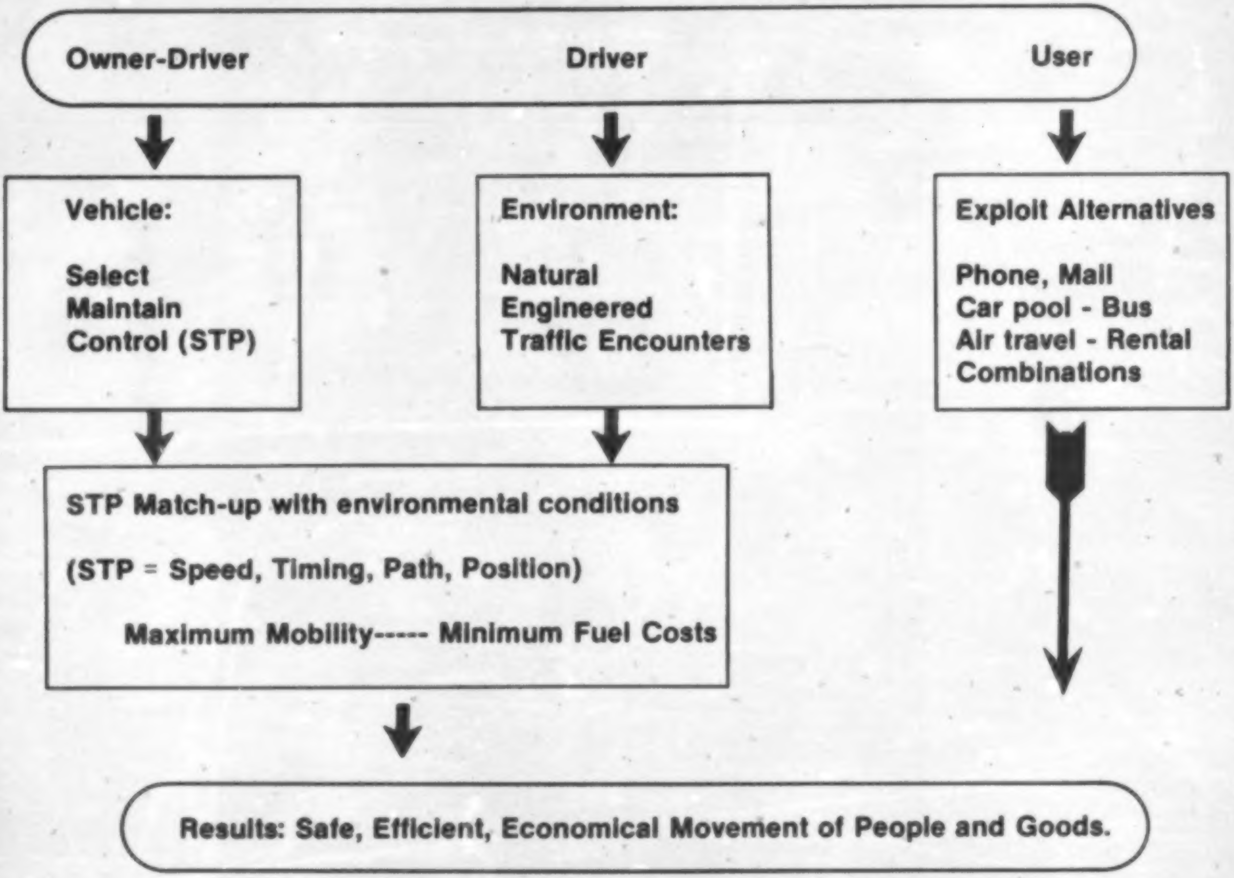
Not so slow that you waste fuel

Not so fast that:

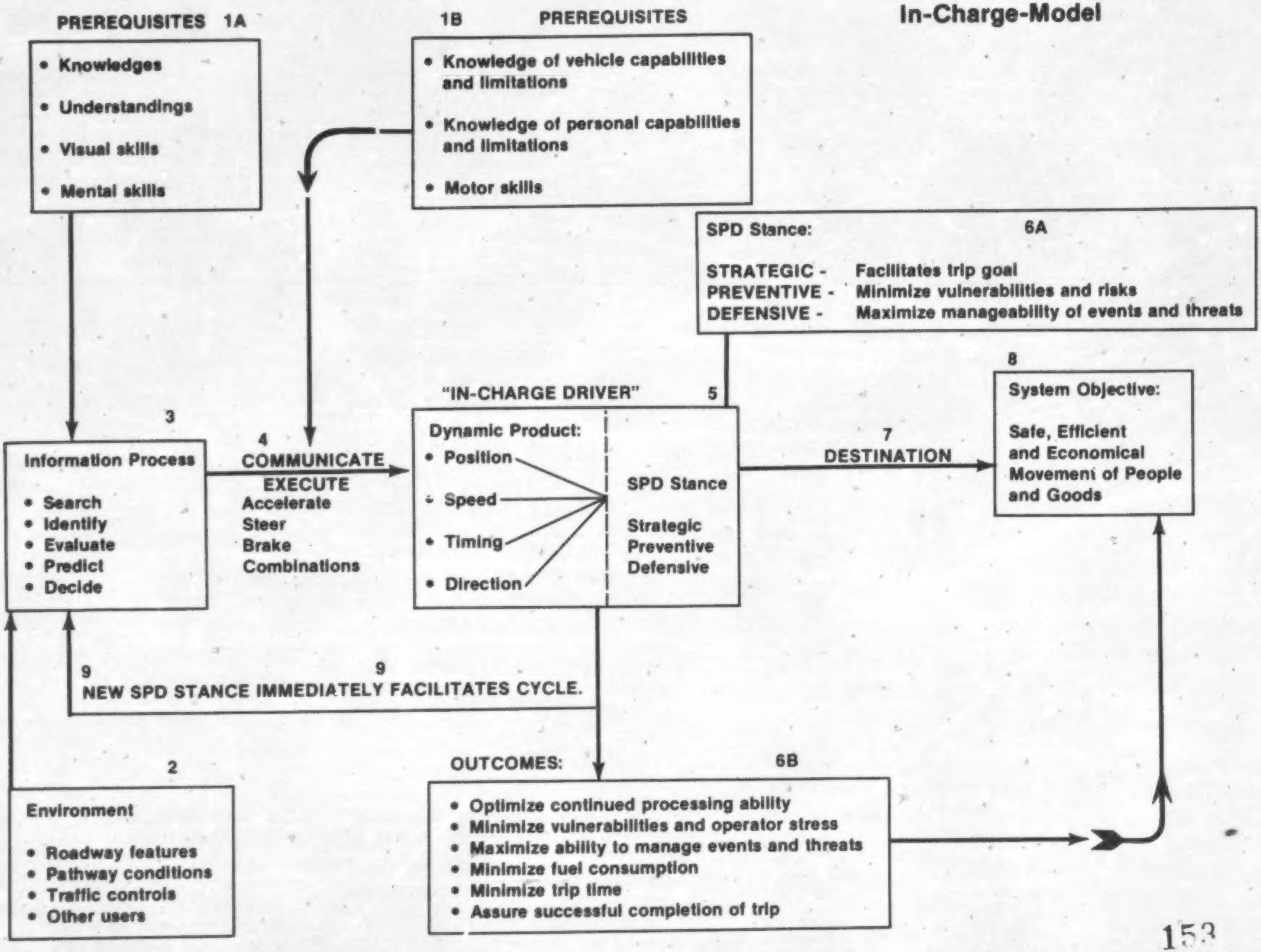
1. You damage your vehicle
2. You lose control
3. Risk a crash
4. Violate the law

NEVER MAKE A SAFETY TRADE-OFF TO SAVE FUEL

Safe and Fuel-Efficient Driving Model


Owner-Driver
Driver
User
Vehicle:
Select
Maintain
Control (STP)
Environment:
Natural
Engineered
Traffic Encounters
Exploit Alternatives
Phone, Mail
Car pool - Bus
Air travel - Rental
Combinations
STP Match-up with environmental conditions
(STP = Speed, Timing, Path, Position)
Maximum Mobility----- Minimum Fuel Costs
Results: Safe, Efficient, Economical Movement of People and Goods.

In-Charge-Model



PREREQUISITES 1A

- Knowledges
- Understandings
- Visual skills
- Mental skills

1B PREREQUISITES

- Knowledge of vehicle capabilities and limitations
- Knowledge of personal capabilities and limitations
- Motor skills

SPD Stance: 6A

STRATEGIC -	Facilitates trip goal
PREVENTIVE -	Minimize vulnerabilities and risks
DEFENSIVE -	Maximize manageability of events and threats

3

Information Process

- Search
- Identify
- Evaluate
- Predict
- Decide

4

COMMUNICATE

EXECUTE

Accelerate
Steer
Brake
Combinations

"IN-CHARGE DRIVER" 5

Dynamic Product:

- Position
- Speed
- Timing
- Direction

SPD Stance

Strategic
Preventive
Defensive

7

DESTINATION

8

System Objective:

Safe, Efficient and Economical Movement of People and Goods

9 9

NEW SPD STANCE IMMEDIATELY FACILITATES CYCLE.

2

Environment

- Roadway features
- Pathway conditions
- Traffic controls
- Other users

OUTCOMES: 6B

- Optimize continued processing ability
- Minimize vulnerabilities and operator stress
- Maximize ability to manage events and threats
- Minimize fuel consumption
- Minimize trip time
- Assure successful completion of trip

Steady Speed Strategies for "In Charge" Drivers

The steadier the speed, the better the fuel economy.

Establish STP Combination:

- Speed
- Timing
- Path
- Position

Away from parked cars:

- Minimize vulnerabilities
- Street choice

Position Vehicle:

- For visibility
- Maneuvering space
- Stopping distance

Follow 2 seconds or more:

- Don't blind-spot
- No side-by-side
- Stay out of bunches

Concentrate and plan

You need time to see, think and act.

LOOK FAR AHEAD

Look for:

- Threats and hazards
- Blocked path
- Traffic controls
- Pathway conditions
- Other users

Change STP combination as needed.

In order of Desirability . . . . .

1. Change path-position
2. Change speed
3. Combination of speed and path
4. Stop

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